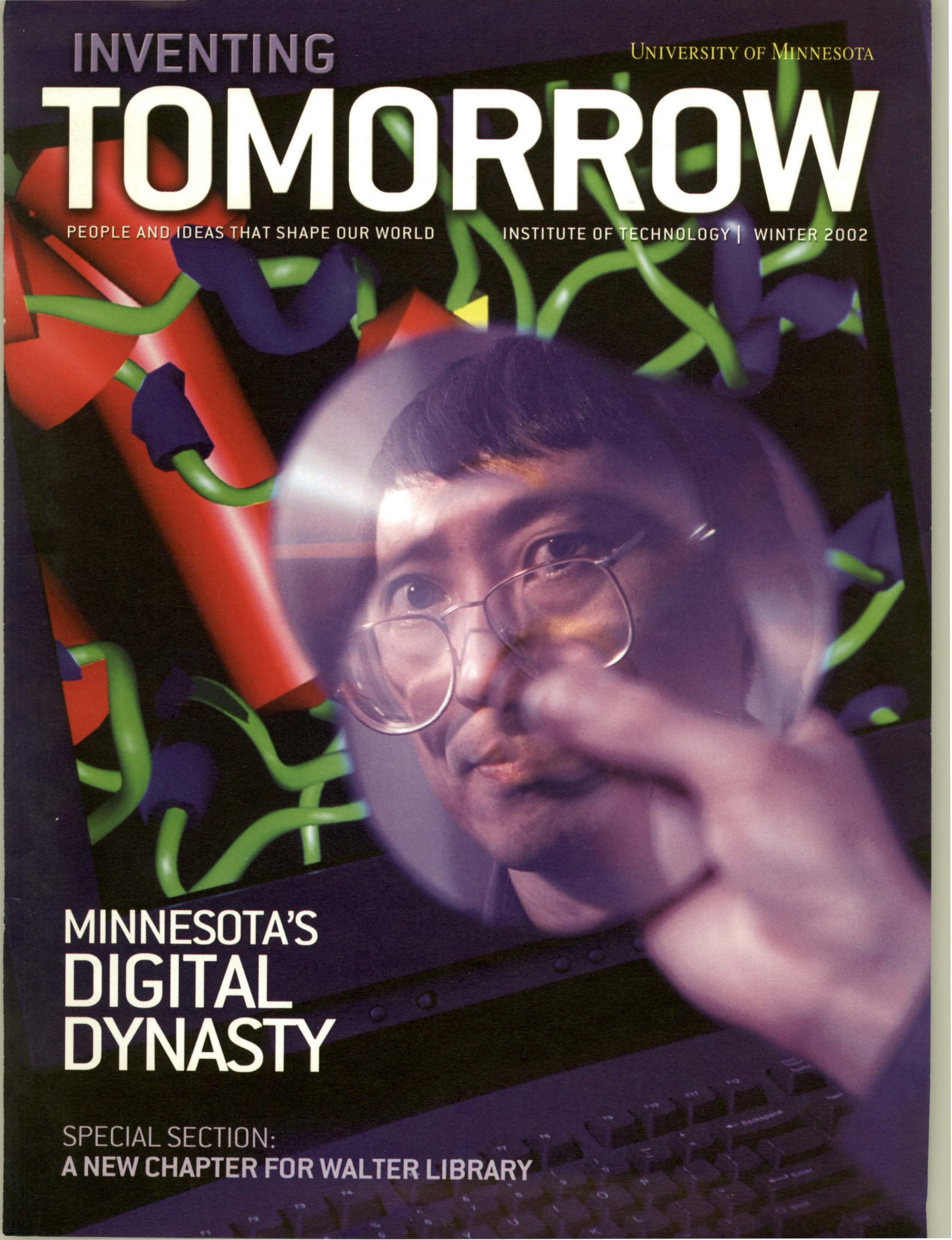
UNIVERSITY OF MINNESOTA

INVENTING TOMORROW

PEOPLE AND IDEAS THAT SHAPE OUR WORLD

INSTITUTE OF TECHNOLOGY | WINTER 2002

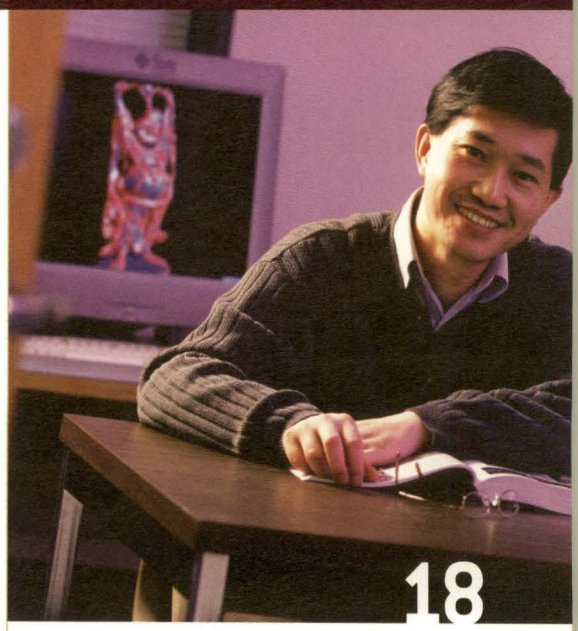


MINNESOTA'S DIGITAL DYNASTY

SPECIAL SECTION:
A NEW CHAPTER FOR WALTER LIBRARY

INVENTING TOMORROW

Winter 2002 | Vol. 27, No. 1



IN THIS ISSUE

IN EVERY ISSUE

ON THE COVER: Chemistry professor Jiali Gao uses techniques developed by computational chemists and computer scientists to model and access the large amounts of data stored in bio-macromolecules like DNA. PHOTO BY JONATHAN CHAPMAN

LEFT: A male figure, Wisdom, ponders a text in the sculpted lunette crowning the door from Walter Library's Great Hall to the south reading room. PHOTO BY PATRICK O'LEARY

www.it.umn.edu

INVENTING
TOMORROW

Winter 2002 | Vol. 27, No. 1

Publisher

University of Minnesota
Institute of Technology

Administration

H. Ted Davis
Regents Professor and Dean

Editorial Staff

Paul Sorenson
Director of Communications
Managing Editor and Designer

Carolyn Wavrin
Senior Editor

Tracey Wilson
Contributing Editor

Susan Wagner
Proofreader

Editorial Advisory Board

Steven Crouch
Michelle Hopewell
Jim Kakalios
Steve Biever
Kristine Kosek
Vaughan Voller

Inventing Tomorrow is published three times a year for alumni and friends of the Institute of Technology. This publication is available in alternate formats for those with visual impairments; call 612-626-7959. The University of Minnesota is an equal opportunity educator and employer.

Printed on recycled paper.

TELL US WHAT YOU THINK

Inventing Tomorrow welcomes letters from readers. Share your memories of campus life, tell us about your activities, react to a story, or let us know what you think about a particular issue. Submissions may be edited for clarity and length. Send your letters to:

U.S. Mail
Editor
Inventing Tomorrow
Institute of Technology
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

Email
inventingtomorrow@it.umn.edu

Facsimile
612-624-2841

Web
www.it.umn.edu

BEING GREEN

I ENJOYED THE ISSUE on IT faculty, students, and alumni who are making the world a greener place. I'm also trying to do that. I am now teaching a course in green chemistry (pollution prevention) for the sixth year at the University of Delaware. My combination textbook-sourcebook, *Introduction to Green Chemistry*, was published by Marcel Dekker in April 2001. Environmental chemistry deals with how to analyze and remediate what man has put into the environment that should not be there. Green chemistry deals with preventing it from getting there in the first place. The goal is to make the items that society needs without the use of toxic chemicals, without toxic waste and with a minimum of energy, for a sustainable future.

Al Matlack *(Chemistry Ph.D. '50), Hockessin, Delaware*

THE END OF THE LINE

PAUL JOHNSON'S LETTER IN THE summer 2001 issue of *Inventing Tomorrow* jogged my memory of that same period. I was also one of the crowd of GIs going to college under the GI Bill at the University in the fall of 1946. Looking back, I realize what a priceless gift our country gave to those of us who served in the military. The opportunity the GI Bill gave me greatly affected my whole life, and I will be forever grateful.

But it was no bed of roses! I was very late in registering in IT that fall. I had registered at North Dakota Agricultural College (NDAC), intending to go to a small school for this first year or two and then transfer to the University. The polio epidemic changed all that. NDAC postponed the start of classes for three weeks, so instead of idling that time I elected to go to the University.

Registering late meant that I ended up with a horrible split schedule, starting with 8 a.m. classes and ending with chemistry lab at 10 p.m. I vowed to never register late again! At that time, to ease the crush of the very large enrollment, IT devised a numbering system dictating your sequence of registration. The registration sequence numbers were to be assigned at an early hour in what is now Amundson Hall. I joined the huge line at a point where I thought I would obtain a low number. I didn't reckon with the eagerness of the other GIs. I ended up a half block away, standing on the snowy sidewalk with the line forming behind me beyond the end of the block!

Since so many men were standing outside on a cold morning, the line in the long hall inside was doubled over in an "S" shape to bring more persons inside. I finally got into this snaked line inside, gradually winding back and forth to the window where the precious numbers were assigned. All of a sudden, someone broke the line, and the ensuing melee resulted in one huge, wall-to-wall mob heading for the target window! We were packed so tightly that a door was pulled off its hinges, and anyone next to the walls had to push with their legs and arms against the wall to get around water fountains without being injured. Somehow, I finally got my registration sequence number that day!

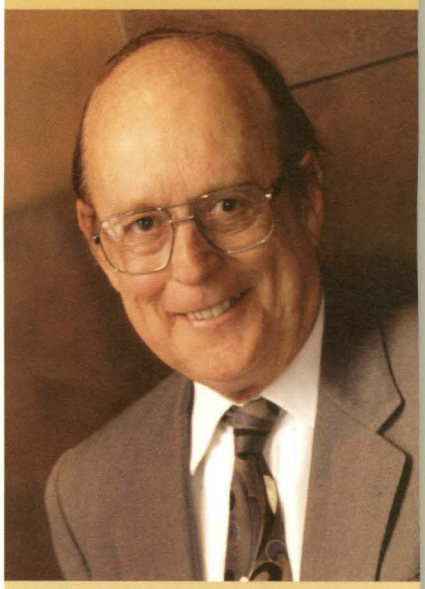
Curt Nelson *(EE '50)*
Minneapolis, Minnesota

In 1947, the line of students waiting to register for classes stretched for blocks on Church Street SE outside Morrill Hall.

UNIVERSITY ARCHIVES

Walter Library's renovation creates a feast for the eye and opens the door to the future

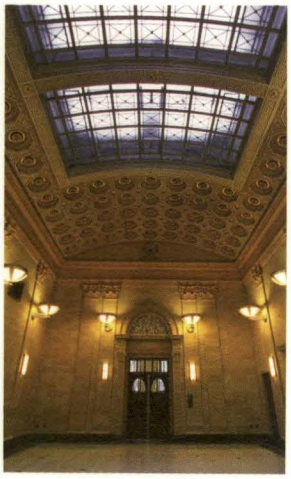
Realizing our dreams



IF YOU'VE EVER UNDERTAKEN a home remodeling project, you know how wonderful it feels to apply that final coat of paint, sweep away the debris, and arrange the furnishings just so. Best of all, you invite your family and friends over to share your pleasure and admire the results of your hard work.

That's just how my colleagues and I feel right now. We've recently moved back to Walter Library, which has undergone an amazing transformation over the past two and a half years. On paper, the scope of the building's $63.4 million renovation was impressive; in person, it's extraordinary.

Walter Library offers the best of both worlds: a state-of-the-art, high-tech facility that's also a feast for the eye. Floor to ceiling, it's rich in architectural details, color, and textures that create a warm, welcoming environment in which to work or study. Those of you who remember the old Walter Library will be amazed at the beauty that lay dormant under layers of paint and grime.



Gone is the old stack core; in its place are modern classrooms, offices, laboratories, and research facilities. After years of planning, the Digital Technology Center (DTC) is now a reality. Under director Andrew Odlyzko, the interdisciplinary center will work to advance the University—and Minnesota—as a national leader in digital and information technology.

Our faculty and students are delighted with the new Science and Engineering Library facilities, which include a completely refurbished stack area and magnificent second-floor reference room. The library offers over 1,000 electronic resources, digital scanning services, and high-speed Internet access for laptops (wireless access will be added soon). The library staff is also creating a state-of-the-art digital library that will feature many new plug-and-play technologies.

The people of Minnesota can expect a great return on their investment in the DTC and in education. But we must continue to develop our strengths and to invest in critical areas. That's why your support for the University's 2002 capital funding request—$239.8 million over the next two years—is so crucial. The request includes $3 million for designing a teaching and technology center for IT that will allow us to increase the number of students enrolled in technically demanding and high-growth programs.

The new building will also enable us to begin a series of renovations that will provide expanded, modern teaching and research facilities for physics and astronomy, geology and geophysics, and computer science and engineering. For more information, see www.umn.edu/urelate/request/.

Walter Library—a wonderful instruction and research facility for the 21st century—is proof that dreams do come true. In this issue you can read about the renovation and take a visual tour. Better yet, come to campus and see it for yourself. You'll be so proud of what we've accomplished together. ■

H. Ted Davis

The people of Minnesota can expect a great return on their investment in the DTC and in education. But we must continue to develop our strengths and to invest in critical areas.

TIN WHIMSY

A TOWERING "TIN MAN" NOW GREETS VISITORS TO THE COURTyard between Lind Hall and the new mechanical engineering facilities. The whimsical "Platonic Figure," a 35-foot-tall, 6,000-pound stainless steel statue stands on seven-foot limestone columns near the Mechanical Engineering Building's south entrance. Award-winning Minneapolis sculptor Andrew Leicester, who has created 20 major public artworks in the U.S., designed the sculpture as a tribute to Leonardo da Vinci's famous drawing "Vitruvian Man."

The piece, dubbed "Tin Man" by University faculty and staff, stands with feet apart, arms raised, holding a curved steel bar. The sculpture's torso and limbs are created with conical forms, while its helmet-like head is reminiscent of robots depicted in 1950s pop culture.

Leicester interviewed dozens of faculty and staff before designing the sculpture. "Ultimately," he says, "I want the sculpture to be a memorable icon within an environment that is not easy to remember or find your way around."

Mechanical engineering professor Steven Girshick says the figure evokes "a vaguely humorous feeling that emanates from the robot-like appearance, expressing our ambivalence about the ever-increasing role of technology in our lives."

The sculpture was funded by the University's Public Art on Campus Program, which commissions and purchases artwork to enhance the University's physical and aesthetic environments.

JONATHAN CHAPMAN

THREE IT FACULTY NAMED TO NAE

CHEMICAL ENGINEERING AND MATERIALS science professors Frank Bates, Edward Cussler, and Kenneth Keller are the latest IT faculty members to be elected to the National Academy of Engineering (NAE), one of the highest professional distinctions accorded an engineer.

Bates, a Distinguished McKnight University Professor and department head since 1999, was honored for his contributions to the phase behavior of polymer blends, especially block copolymers. He received his master's and doctoral degrees from Massachusetts Institute of Technology and joined the University faculty in 1989.

Cussler, an IT Distinguished Professor, was honored for his pioneering research on membrane transport in chemical and biochemical separation and for his inspiring teaching. He received his master's and doctoral degrees from the University of Wisconsin-Madison and joined the University faculty in 1980.

The NAE selected Keller for his leadership in the application of quantitative engineering analysis to vascular transport and in public policy. He received his master's and doctoral degrees from Johns Hopkins University and has been a University faculty member since 1964. He served as department head from 1978 to 1980 and as University president from 1980 to 1988. Currently he also directs the Center for Science, Technology, and Public Affairs.

Twenty-nine IT faculty members have been elected to the NAE since 1969.

IN MEMORIAM

HENDRIK OSKAM, PROFESSOR emeritus of electrical and computer engineering, died October 14, 2001, from lung cancer. Oskam, 78, specialized in physics and plasma engineering during his 30-year tenure at the University. A native of the Netherlands, Oskam left college during World War II to serve in the Dutch Resistance. He supplied food to people hiding Jewish families from the Nazis and collected intelligence on German military operations. He spent two years in Nazi labor camps in the Netherlands and Germany. Before coming to Minnesota, Oskam worked for Philips Research Laboratories in the Netherlands. He retired from the University in 1990.

ROMAN ARNOLDY (ME '33), 90, died January 18, 2002. The founder of Triten Corporation and several other companies, Arnoldy was known for his many inventions, for which he obtained more than 40 patents. A longtime University benefactor, he served on the University foundation's board of trustees for many years. A train enthusiast, Arnoldy eventually purchased his own private train car, the Intrepid. He was elected to the National Academy of Engineering for his lifetime achievements.

ON THE MOVE

THE RENOVATION AND RESTORATION of Walter Library is complete, and tenants began moving back to the building in December. The library's science and engineering collection reopened in Walter on January 22, and the IT dean's office returned on February 8. The Digital Technology Center and related units will relocate to Walter over the course of spring semester. Grand opening festivities are planned for later this spring.

FORMULA FOR A TOP UNIVERSITY

MINNESOTANS HAVE MORE REASON than ever to be proud of their flagship university.

The University of Minnesota ranks third among the nation's top public research universities, according to a recent study by The Center for Studies in the Humanities and Social Sciences at the University of Florida.

The center's annual report, *The Top American Research Universities, 2001*, ranked 154 public and private universities based on nine measures of performance. The report grouped private and public universities separately but also combined the two categories in a ranked list of the leading American research universities.

The study defined a top research university as one that reports federal research expenditures of at least $20 million and ranks in the top 25 schools on at least one of the nine measures. Minnesota placed in the top 25 institutions on eight of the nine measures. The only other public institutions that scored as well are the University of California-Berkeley and the University of Michigan.

The five institutions that scored higher than the top three public universities are highly selective private schools: Cornell University, Harvard University, Massachusetts Institute of Technology, Stanford University, and the University of Pennsylvania.

"We're certainly in very good company," says IT dean H. Ted Davis. "This report clearly shows that Minnesota's investment in the University is really paying off."

According to the study, the most important measures of a university's excellence are the amount of research and development funding it receives and the caliber of the faculty who compete for this funding. Other indicators measure a university's commitment to advanced study and the ability of its undergraduate programs to attract high-quality students. The study also acknowledged the importance of private financial support to a university's success by including endowment size and annual private contributions as key indicators.

Unlike popular annual college rankings, which favor small, select private universities, the center's report used a broader, more sophisticated range of measures that reflect the complexity and variety of academic institutions. Rather than focusing only on undergraduate education or specific graduate programs, this survey included all the factors that make a university strong.

"Because the University of Minnesota is large, with strength in many areas, we fare well in this new study," says senior analyst Peter Zetterberg of the University's Institutional Research and Reporting Office.

President Mark Yudof cited the University's interdisciplinary initiatives (including genomics, new media, and digital technology), its engineering departments, alumni support, and successful capital campaign as important factors that influenced its high ranking.

The full study is available online at thecenter.ufl.edu.

GETTY IMAGES

R&D
RESEARCH AND DISCOVERY

OLYMPIC MOMENTUM

A WAVE OF OLYMPIC FEVER HIT campus early last spring and lingered until December 22, when three-time Olympic luge veteran Bonny Warner lost her chance to compete in her fourth Olympics. This time Warner hoped to win a medal in women's bobsled, a sport that made its Olympic debut in Salt Lake City in February. She and her new brakeman, Bethany Hart, were eliminated after the second of three runs during the U.S. women's Olympic bobsled trials at Utah Olympic Park.

No one on campus was more disappointed than mechanical engineering professor Art Erdman. In March 2001, Warner asked Erdman and Marge Hartfel (ME M.S. '93, BiomedE Ph.D. '01) to design a system that could analyze the biomechanics of the bobsled start. In both bobsled and luge, a few hundredths of a second can separate the winning team from the competition. Momentum at the start—the first 65 meters of the run—strongly affects the sled's speed throughout the course.

Warner knew that Erdman and Hartfel, a 3M employee, had Olympic connections dating back to the early 1990s, when 3M became a worldwide sponsor of the Olympics and elected to promote the sport of luge. The company asked Erdman and Hartfel to assist its efforts by applying their knowledge of sports biomechanics to luge, and they've continued their involvement over the years.

For bobsled, Erdman came up with the idea of modifying a high-performance treadmill with a computer and instrumentation. The treadmill would simulate the acceleration and incline of a start (from zero to minus seven degrees), a sensor would provide data on the forces applied to the "sled," and the computer would record that data in real time.

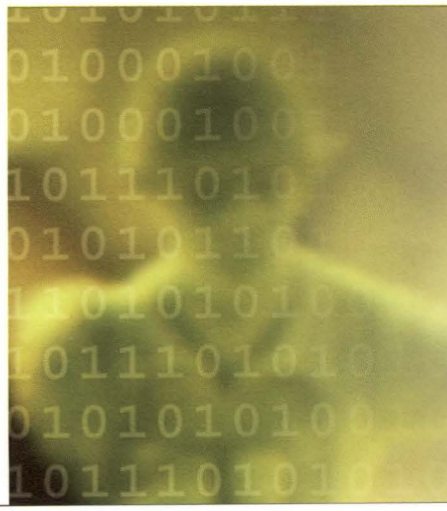
He quickly assembled a team of experts and corporate partners to work on the project, including EnduraTEC, Aspen Research, and Frappier Acceleration Sports Training.

Warner came to campus twice last spring to test wood prototypes of the device. "When Bonny came here the second time she could try out the system and see on the computer the results of her runs. Immediately she was getting feedback that was useful to her—it was really neat to see that," says Erdman.

Prototype specifications were later used to build an aluminum model for Warner's training in Utah.

Even during the preliminary design phase, Warner says, the device gave her helpful information. "I changed the [bobsled handle height] from 35 inches to 33-3/4 inches, based on more measured force," says Warner. "This made me very happy, as I had a scientifically determined bar height."

Although she didn't compete in the 2002 games, Warner participated as a commentator for NBC, covering the luge, bobsled, and skeleton competitions.



STRATEGIC SUPERCOMPUTING

UNIVERSITY RESEARCHERS WILL lead an effort to help the U.S. military attack strategic issues using supercomputers, thanks to a new eight-year, $36 million federal grant. Scientists and engineers at the University's Army High Performance Computing Research Center (AHPCRC) will work with experts from the Army and six other universities on interdisciplinary projects ranging from biological and chemical defense to virtual computing environments for future combat systems. The center will also hold introductory and advanced summer institutes in high-performance computing.

"This is a clear recognition of the leadership role played by the AHPCRC in the area of high-performance computing," says the center's director, Vipin Kumar. "We are excited about the opportunity to continue our leading-edge research [and to] focus on new areas of great national importance, such as chemical-biological defense and network intrusion detection."

GETTY IMAGES (2)

CRYSTALLINE CLARITY

IT'S NOT QUITE A MAGIC CRYSTAL, but it has a few dazzling tricks up its sleeve.

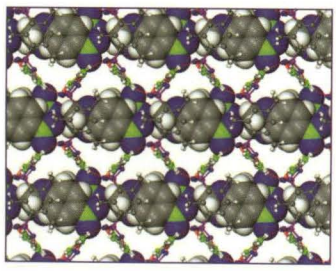
A research team led by chemical engineering professor Michael Ward has created an organic crystal lattice that assembles itself in exact predetermined architecture—a rare feat. The lattice also exhibits polarity, which is as difficult to achieve as coaxing magnets to line up with all the north poles facing the same way.

The technology opens the door to new types of "polar" crystals with exciting potential in fields from telecommunications to medicine.

On the molecular level, a crystal lattice resembles a hotel—a series of chambers housing guest molecules that perform some function. The "floors" and "ceilings" of the chambers are identical sheets of molecules, with "pillars"—a third type of molecule—stretching between them. The floors, ceilings, and pillars are held in place by weak chemical attractions.

"It's usually difficult to get molecules to go the way you want because the forces [pulling them into position] are so weak," says Ward. "What we're doing is crystal engineering, which means designing solid-state structures based on molecules—looking at the molecules and asking how they'll guide themselves into a 3-D crystal lattice."

In order for the crystal to work, its chambers must be identical, and all guest molecules must be aligned in the same direction. The guest molecules move into their chambers while the lattice is assembling itself. But the lattice's symmetrical framework of sheets and pillars offers the guest molecules no clue to the correct orientation. If some guests are standing heads up and others are upside down or sideways, the material as a whole has no sense of direction—no polarity.



The new organic crystals force guest molecules to line up in one direction inside the lattice.

In a polar crystal, one end of a guest molecule is relatively negative in charge; the other end relatively positive. A row of polar guests tends to line up in alternating orientation, so that positive ends are bracketed by negative ends and vice versa. Their charges cancel each other out, and the crystal becomes nonpolar.

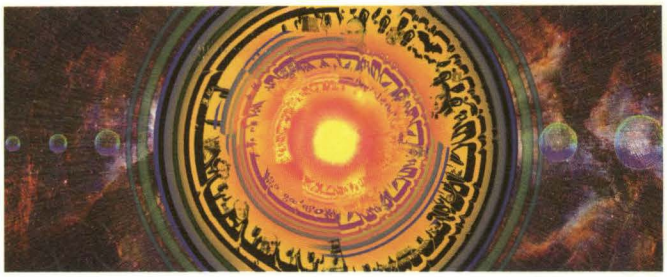
But Ward and his colleagues used banana-shaped pillars that forced all guest molecules to line up in one direction inside the lattice. Because these molecules have the same orientation, the material exhibits polarity.

The new crystals double the frequency of light, a property often associated with polar crystals. This phenomenon means that green or blue lasers can be fashioned using red light. Blue lasers (usually difficult to fabricate) are desirable for telecommunications because they can transmit information faster at higher frequencies and shorter wavelengths.

Related crystal lattices can also be used to separate molecules that have the same composition but different structure, like drugs that exist in two forms. For example, one form of thalidomide alleviates morning sickness but another causes birth defects.

"Now that we know how to do this, we can try other 'pillar' molecules and other 'guests' with the same basic framework," says Ward. "What makes this unique is [that] it's so amenable to modifications."

TOP: COURTESY UNIVERSITY RELATIONS; BOTTOM LEFT: COURTESY PROFESSOR MICHAEL WARD; BOTTOM RIGHT: JONATHAN CHAPMAN



CAVE PAINTING

WHO SAYS CAVE ART WENT OUT WITH THE PALEOLITHIC PAINTERS? Minnesota artist Joseph Giannetti is creating a colorful 25- by 60-foot mural half a mile deep in the Soudan Underground Mine near Tower, Minnesota. The mural will adorn the laboratory where University physicists are probing the nature of tiny subatomic particles.

The Soudan Mine was a working mine from the 1880s until 1962 and is now owned by the Minnesota Department of Natural Resources. The University laboratory was built in the mid-1980s. During the past two years, construction workers have excavated and outfitted a new room for an experiment to probe the nature of elusive particles called neutrinos. Giannetti's mural will cover the wall opposite the gallery and give visitors an artist's impression of the scientific experiment being conducted below them.

In August an international team of scientists began installing the MINOS Far Detector, a 5,000-ton apparatus that will be used to observe neutrinos shot toward the facility from the Fermi National Accelerator Laboratory, located near Chicago. The study, which will search for and measure neutrino mass, is expected to increase understanding of the big bang that formed the universe, the unseen "dark matter" that influences the universe's expansion, and the fundamental interactions between energy and matter.

RECORD RESEARCH, IMPRESSIVE IMPACT

UNIVERSITY RESEARCHERS ATTRACTED $498.4 MILLION IN SPONsored research in 2001, topping last year's record of $455 million by 9.5 percent. The federal government continues to be the largest sponsor of the University's research programs, led by the National Institutes of Health with $217 million. In two years, sponsored research awards have increased by 36 percent, from $365 million in 1999 to this year's $498 million.

A study by the U.S. Department of Commerce examining the University's contribution to the local economy estimates that 37.8 jobs are created in Minnesota for every $1 million spent on University-based research in the state. That ratio translates to more than 15,000 jobs created in Minnesota as a result of University research. According to Christine Maziar, vice president for research and dean of the Graduate School, the continual strides the University is making in research programs are significant for Minnesota.

"It's important because the record award level is another indication that our faculty and researchers are competing on the national and international levels in attracting research dollars," says Maziar. "This support positions us well to continue as a leading research, learning, and outreach institution."

PEAK Experience

An innovative new program introduces IT students to the benefits of study abroad

BY TRACEY WILSON

FOR WEALTHY AMERICANS OF A bygone era, the grand tour was a rite of passage that prepared young people to enter cultivated society. For generations of college students, wealthy or not, study abroad added a special luster to a classical liberal arts education. The attendant pleasures of study abroad—like successfully navigating the slippery terrain of a foreign language or exploring the world's great museums and historic sites—seemed to be reserved for humanities and liberal arts majors.

But the world—and study abroad—have changed. "Study abroad isn't just for privileged liberal arts students anymore," says Susan Kubitschek, international programs director for IT Student Affairs. "A lot of programs have opened up for students with more technical majors."

Today's undergraduates still enjoy the cultural perks of study abroad, but the subjects they investigate and the countries they visit are far-flung and diverse.

Last May, 30 IT students attended Zurich University of Applied Sciences in Winterthur, Switzerland, as part of an innovative new program that dispels many lingering stereotypes about study abroad. Within the span of a few weeks, they toured the world's largest particle physics center, studied systems engineering, and enjoyed the beauty of snow-capped Alpine peaks.

The trip, which was initiated by mechanical engineering professor Art Erdman, was several years in the making. In 1994, Erdman began teaching a graduate-level course on new product design and business development. While teaching the course, he established contacts with several Swiss biomedical companies. After the companies said they wanted to work with Twin Cities biomedical companies, Erdman and the University were involved in establishing the Winterthur Consortium, whose membership includes 30 companies, banks, and the University.

Shortly after the consortium was created, Professor Walter Schnueriger of Zurich University of Applied Sciences expressed a strong desire to "tie our curriculum, faculty, and students together," says Erdman.

As a first step, two students from Zurich University of Applied Sciences came to the University in September 2000 to study for a year. Says Erdman, "After the success of that trip, my colleagues at Zurich said they would be happy to develop a course specifically for IT students."

"More than anything else, study abroad will change the way you see yourself, your country, and the world."

—SUSAN KUBITSCHEK

Erdman consulted Kubitschek for advice on devising a flexible study abroad program that would appeal to students in various IT majors. She recommended the Global Seminars program, which was created by the University's Global Campus office for students who don't have the time, desire, or finances to study for a year overseas. Global Seminar participants complete a three-credit course in three weeks, either during winter break or May intersession. Program costs range from approximately $2,100 to $3,600.

According to Erdman, the program is ideal for IT students. "It allows academic departments to custom-design a Global Campus seminar for students," he says. "That was really important because the course had to appeal to a number of diverse majors in IT."

But designing such a course is tricky. For example, says Erdman, a seminar that attracts mechanical engineering majors might not necessarily interest computer engineering students. However, Erdman and his Swiss colleagues came up with a clever solution: a course in mechatronics, which combines aspects of mechanical engineering, computer science, and electrical engineering.

"It was a very lucky connection because IT has a mechatronics lab, and mechatronics is one of the top research interests at Zurich University," he says. "It is a very neutral drawing topic."

To ensure the program's appeal and its ultimate success, Erdman and Kubitschek planned the inaugural seminar carefully. The program was scheduled for May 2001

JONATHAN CHAPMAN

Among those who traveled to Switzerland last May were (standing) Susan Kubitschek, Jason Olmanson, Nate Zimmermann, Kale Schulte, Professor Art Erdman; (kneeling) Candy Pederson, Sara Citrowski, Charlie Steidl, Brian Mader, Jeremy Dresel, and Matt Dummer.

intersession, with the group departing for Switzerland on May 14 and returning home June 2. Limited to juniors and seniors, the course fulfilled a technical elective. Because the Swiss professors, hosts, and tour guides all speak fluent English, language wasn't a barrier.

The program's cost—$3,200—included airfare, tuition, housing, some meals, in-country transportation, excursions, entrance fees, and insurance. To help defray the cost, each student received a $500 travel grant from IT and the student's department. Open-ended airline tickets gave students the option of traveling on their own after completing the seminar.

Throughout the trip, Kubitschek and Erdman would accompany the students and stay with them in the dorms.

The two then launched a publicity campaign, including a series of meetings designed to gauge student interest. Erdman announced the program to his Machine Design II class, and Kubitschek sent out emails and printed flyers with a headline query: "Who wants to go to Switzerland?"

They had hoped to enroll about 20 students in the seminar, but by the deadline 42 students had submitted trip deposits.

"It was more that we could have hoped for," says Kubitschek. "I had no idea that IT students would be so enthusiastic about a seminar in Switzerland."

Mechanical engineering senior Jeremy Dresel, one of the first students to sign up, says he'd been searching for a similar opportunity for quite a while. "I have always wanted to do some traveling overseas," he says. "The course and the costs were perfect, and I jumped at the chance."

By the time they left for Switzerland, the students were well-prepared for their trip. They had attended orientation sessions at the Global Campus center, and two professors flew in from Zurich University of Applied Sciences to give students an insider's perspective on Switzerland and its people.

Electrical engineering senior Candace Pederson says the seminar really helped her prepare for the trip. "Because we were able to ask so many questions and get so

SEE **EXPERIENCE**, PAGE 13 ▶

Superhero SCIENCE

Jim Kakalios enlists the aid of costumed crimefighters to teach critical thinking in an imaginative freshman seminar

BY PAUL SORENSON

SOMEWHERE IN A PARALLEL universe, a mild-mannered physics professor named Jim Kakalios dons a cape and tights to battle the forces of evil.

In our own dimension, Kakalios—an unabashed comic book enthusiast—teaches physics with the zest of a costumed crimefighter, illustrating his points with examples from the annals of superhero history.

Last fall the superheroes moved to the head of his class. In an imaginative new freshman seminar, Kakalios uses concepts and characters from comic books to explore basic principles of physics, chemistry, and biology. The course—Everything I Know About Science I Learned from Reading Comic Books—attracted students from a wide variety of disciplines.

It's a fitting venture for Kakalios, whose lifelong love of comic books helped cultivate his passion for science.

"As a kid, comic books helped fuel my curiosity," he recalls. In one story, his favorite hero, The Flash, lost his ability to avoid air resistance and friction. "It made me aware [that], aside from the silly notion of superpowers, there were all sorts of secondary issues associated with the ability to run superfast that I hadn't considered."

Convinced that comics could help make science more accessible and appealing to students of any age, Kakalios toyed for years with the notion of creating a class on the science of superheroes.

Comic books made their first foray into his classroom in 1993, when he posed a question about the death of Spider-Man's girlfriend, Gwen Stacey, on an introductory physics exam.

Stacey's death was a seminal event in comics, says Kakalios. Hurled from the top of the George Washington Bridge by the evil Green Goblin, she died in Spider-Man's web as he tried to save her. Although she appeared to have suffered a broken neck when she hit the web, the series' writers later attributed her death to the "shock of the fall," an explanation that left many readers—including Kakalios—unsatisfied.

Twenty years after the story first appeared, Kakalios and his physics course settled the matter once and for all. "Gwen Stacey's fall is basically a standard problem that we would ask on an exam: If you fall 90 meters with an initial velocity of zero, how fast are you going at the bottom?"

The answer he calculated removed any doubt about the cause of Stacey's death: She was falling at roughly 95 miles per hour when she hit the web; the impact on her body would have been 10 to 20 times the force of gravity. "That proved—mathematically at least—that Gwen Stacey died of a neck snap when Spider-Man caught her in his webbing."

The problem—a favorite among students—soon earned Kakalios wider notoriety in the comic book world. In 1997, a

COURTESY MARVEL COMICS GROUP

JONATHAN CHAPMAN

comic book magazine called *Wizard* published an issue devoted to resolving long-standing comic book questions. Kakalios wrote to the editor, University alumnus Jim McLauchlin, to offer his explanation of Stacey's death. McLauchlin published the letter, and Kakalios earned a spot as *Wizard*'s "resident rocket scientist."

In the new seminar, Kakalios and a dozen students tackled a variety of super-problems like shape-shifting and invisibility. Shrinking, for example, was fraught with difficulties. If the laws of physics applied, insect-sized Ant-Man would become deaf and speak with a hypersonic voice because his eardrums and vocal cords would shrink to submillimeter sizes. Typical air currents would easily blow him across the room, and a drop of water would double his weight, immobilizing him like a real ant.

In addition to identifying such scientific bloopers, the class examined cases in which comic creators got the science right.

"Take Superman," says Kakalios. "In his very first year, he could only leap, not fly. His skin was tough, he had great strength, all because [his home planet] Krypton had larger gravity than Earth." Using the hero's ability "to leap over tall buildings in a single bound" as a benchmark, the class calculated that Krypton's gravity would have to have been six to eight times that of Earth.

That means Krypton had to be either six times larger or six times denser than Earth. Assuming that normal matter on Krypton obeys the laws of physics, the planet could not be six times denser than Earth. "So Krypton had to be six times larger," explains Kakalios. "But any planet that much larger than Earth would have to be a gas

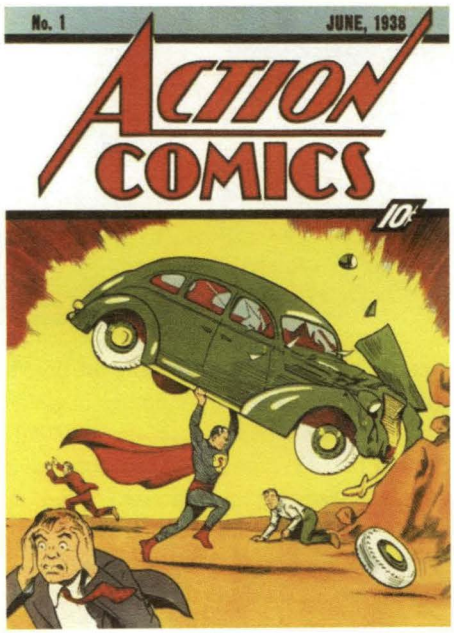
giant like Jupiter. Because Krypton had a solid crust supporting buildings and cities, the only other explanation for its increased gravity would be a super-dense—and unstable—material like a neutron star in its core. And that would explain why Krypton exploded.

"Of course, [Superman's creators] didn't know it at the time. They got the science right by accident," says Kakalios.

The Man of Steel, introduced in 1938, was an anomaly among Golden Age heroes, says Kakalios. "Most of the characters introduced in the 1930s and 1940s got their powers through magic or mysticism," he says. As stories were retold for subsequent generations, many characters were updated to reflect advances in science and technology.

"For example, the original Green Lantern (introduced in 1940) had a magic lantern and a power ring that was vulnerable to wood. In the 1960s, Green Lantern got a scientific makeover." His powers were similar, but there was now a quasi-scientific explanation for his abilities: The lantern was extraterrestrial, and an impurity in his ring now made the Green Lantern vulnerable to the color yellow.

Characters created in the 1950s and 1960s often owed their powers to radiation or mutation. When Spider-Man (Peter Parker) was introduced in 1962, he owed his extraordinary abilities to the bite of a radioactive spider. When his origin was retold in the 1990s, the science was updated to reflect current trends: Parker's powers now result from the bite of a genetically engineered spider.



Superman, introduced in June 1938, was one of the first heroes whose powers had a quasi-scientific basis rather than a mystical source. His early exploits formed the basis of several problems in Kakalios' new course.

Students in Kakalios' course examine the ways in which many enduring characters from the 1930s and 1940s—like those in the Justice League—have been updated over the years to reflect advances in science and technology.

Although contemporary comic books are more grounded in science than they used to be, "they still require a willful suspension of disbelief," says Kakalios. "The best ones require only one 'miracle'—one thing you have to buy into to make the hero plausible—and the rest should follow."

One of Kakalios' favorite stories acknowledges this leap of faith. "There's a panel in which The Atom and another character have shrunk to submolecular size, and they're sitting on an electron," he recalls with a grin. "The Atom's companion says, 'We're smaller than an oxygen molecule. How are we breathing?' The Atom replies, 'I've never really figured that out.'"

But the course isn't about debunking various characters or storylines, Kakalios explains. The analysis is all part of the fun.

"The most important thing is getting the students to ask the right kinds of questions," he says. "If a character has wings on her back, what important physical forces and issues do we need to consider if she's going to use them to fly? What kind of wingspan and muscle structure would that require? Hopefully, pointing out issues like that will help them think critically in other situations."

As a final project, each student selected a favorite comic book superhero and examined the scientific basis of the character's abilities. The analyses covered a wide range of genres, from superheroes to *The Simpsons*.

One of Kakalios' personal favorites—the elastic Mr. Fantastic—could serve as a role model for his students. "Reed Richards [Mr. Fantastic] had these powers that allowed him to stretch and assume different shapes, but he often used his intellect [to defeat the villain]. He was the smartest man in the Marvel Comics Universe, and he showed that being intelligent could be cool and useful."

But when Mr. Fantastic's exploits sometimes defy explanation, even Kakalios the professor can set aside his scientific proclivities.

"It's escapist fiction, so I just turn off that part of my brain and enjoy the stories on their own terms," he says. ■

FOR MORE ON THIS STORY, TURN TO PAGE 51.

EXPERIENCE

CONTINUED FROM PAGE 9

many details, I felt like I really knew what we were getting into," she says. "It really got me psyched about the trip."

Kubitschek, who had never been to Switzerland, says the students' enthusiasm helped calm her fears about shepherding a group of adventuresome young people. "I stopped worrying and just thought about how wonderful it was going to be in Switzerland," she says. "I was really looking forward to it."

Electrical engineering senior Michael Aanenson says he couldn't sleep the night before departure because he was "thinking of what lay ahead," but he had plenty of time to catch up on his sleep during the 15-hour flight.

At the airport, a host greeted the travelers enthusiastically, and their excitement and anticipation quickly trumped crankiness and fatigue. Throughout the trip, the Swiss proved to be as precise and polite as their reputation, according to Kubitschek. "I had no idea how easy it would be for us. They were more well-organized and prepared than I could have imagined."

On the ride to the university, students got their first look at Switzerland. Pederson was struck by how "clean and narrow the streets were." Aanenson felt the town seemed almost deserted because "there was really no traffic and not a lot of cars."

Upon their arrival at the dorms, students were assigned email accounts and matched with a student mentor who served as their guide and contact throughout the trip.

After attending classes from 7:50 a.m. to 5:15 p.m., students were free to explore the city. From Thursday through Sunday, they enjoyed many scheduled activities and excursions. During the first week, students visited the cities of Berne, Neuchâtel, Geneva, and Valais; toured the Swiss Center for Electronics and Microtechnology and the European Organization for Nuclear Research (CERN), the world's largest particle physics center; and spent one night at Zermatt, an exclusive resort located at the foot of the Matterhorn. At least two professors from Zurich University of Applied Sciences accompanied the students on all their excursions.

"The Swiss designed the program so that students would learn as much from discussions with their professors on buses or trains en route to different sites as they would in the classroom," says Erdman.

The course work itself proved to be challenging. Students adhered to a rigid schedule of exams and papers, spending much of their free time in study groups. Although he'd heard that study abroad didn't involve much work, jokes Aanenson, "our hosts at Zurich didn't hear that."

Kubitschek and Erdman also attended class sessions. "Their system is very different from ours. In many countries, students aren't allowed to interrupt their professor and ask questions," says Kubitschek. "I wanted to make sure our students felt comfortable and had the freedom to ask questions and interact with the professors."

But the students did have to conform to Swiss standards of punctuality. Tardiness wasn't tolerated under any circumstances.

"The Swiss designed the program so that students would learn as much from discussions with their professors on buses or trains en route to different sites as they would in the classroom."

—PROFESSOR ART ERDMAN

"There were no students drifting into class at 8:15 a.m. Students had to be sitting in class at exactly 7:50, pen in hand, and ready to learn," says Kubitschek. "No matter how tired the students were, everyone got to class on time."

Some had reason to be tired. Kubitschek laughs when she recalls getting up in the middle of the night on more than one occasion to remind "jabbering students to keep it down—some of us are trying to sleep!"

Although they never encountered any language barriers or huge cultural disparities, after a few days students noticed subtle differences between the U.S. and Switzerland.

Mechanical engineering senior Kale Schulte says he appreciated the Swiss attitude toward life and work. "They really know how to relax and enjoy life. The stores all close really early there, like 6:00 p.m. People over there don't seem to be obsessed with things as much as we are here. It's nice."

Pederson was surprised by how much the Swiss knew about the U.S. government and national issues. "They used to ask us about a specific bill that passed through Congress or a certain congressman or senator. They knew the details most Americans wouldn't have known," she says.

The high cost of food shocked Dresel. "[The food] was excellent, but in the U.S. I can get lunch for $5. I could not get any meal there for less than $15."

Out of more than 20 excursions, students most enjoyed a trip to view Switzerland's majestic snow-covered peaks. During an overnight stay at an authentic Swiss Alpine Club, they hiked to the Lidernenhutte, one of the country's most picturesque sites. Schulte's face lights up at the memory.

"I cannot describe to you accurately the beauty of that whole experience. I just don't have the words," he says. "To stand on that gorgeous snowy mountain and feel the warm air was one of the most moving experiences of my life."

The University wants more students like Schulte to savor the pleasures and advantages of study abroad. Over the next five years the University intends to increase the proportion of students enrolled in study abroad programs from the current 20 percent to 50 percent. Kubitschek is confident that the number of IT students who study abroad will steadily increase.

"Look at the statistics," she says. "In 1997, only six IT students studied abroad. In 2001, that number increased to 128. These Global Seminars will keep those numbers rising."

More than 20 students already have expressed interest in a Global Seminar that will take students to Beijing, China, in May 2002. Kubitschek believes the trip will be more challenging than the Switzerland excursion, but she's confident that students will find it just as rewarding.

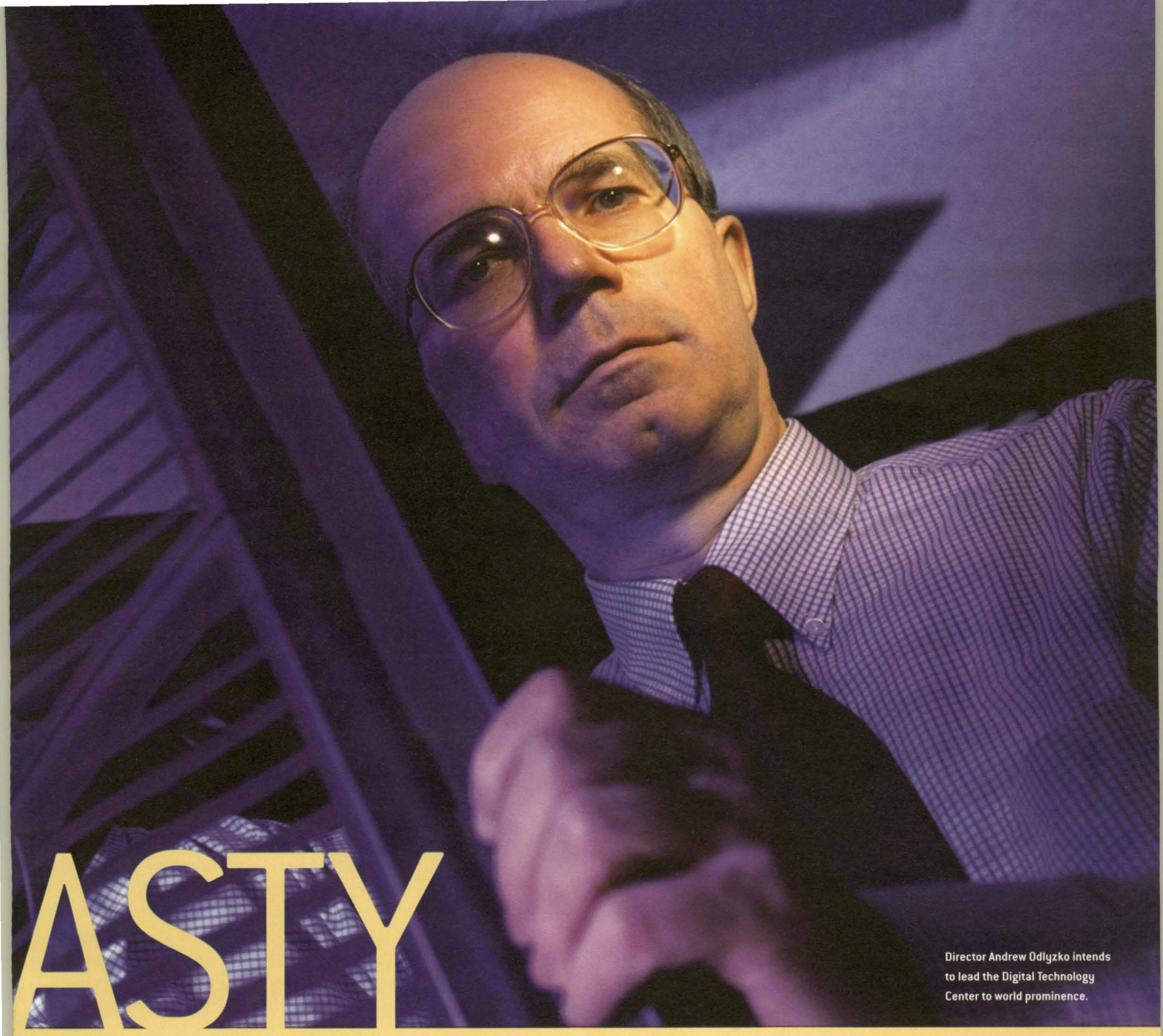
"More than anything else, study abroad will change the way you see yourself, your country, and the world," she says. ■

FOR MORE ON THIS STORY, TURN TO PAGE 51

An infusion of talent, resources, and ambitious goals backs the University's digital technology initiative. From its high-tech home in Walter Library, the new Digital Technology Center is poised to reestablish

MINNESOTA'S DIGITAL DYN

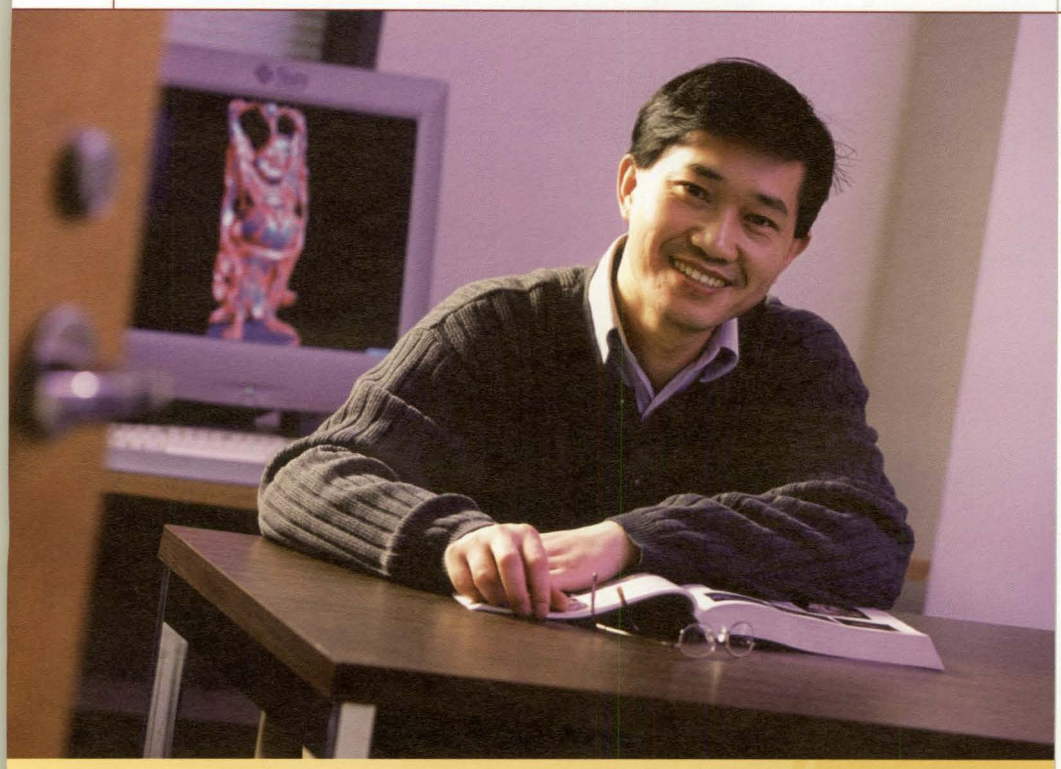
TEXT BY JUDY WOODWARD | PHOTOS BY JONATHAN CHAPMAN



ASTY

Director Andrew Odlyzko intends to lead the Digital Technology Center to world prominence.

MANY GENERATIONS AGO, giants emerged from the land of ice and snow to dominate the world. But, much like the dinosaurs, they receded into the mists of time as conditions changed and new species evolved. | Despite the brevity of their existence, these behemoths changed our world within the course of a few decades. Starting in the 1960s, large-scale mainframe computers and supercomputers launched the Information Age and dominated computer technology. Well into >>



"My research involves turning three-dimensional data into two-dimensional images. The general purpose is always to do fast and efficient rendering of images." —ASSISTANT PROFESSOR BAOQUAN CHEN

the 1970s and beyond, much of the research and development responsible for those giant computers was figuratively stamped "Made in Minnesota." Then in the 1980s came the rise of the personal computer, followed by a decade during which ever-smaller and increasingly powerful devices were introduced. The emphasis on large-scale computing declined, and the focus shifted from Minnesota to California's Silicon Valley and other West Coast cradles of technology.

Now the University is moving to help Minnesota regain its leadership in the field. Digital technology was one of five key areas named by President Mark Yudof in 1997 as essential to strengthening the University and advancing the state's economy.

Just as digital technology has revolutionized nearly every aspect of contemporary life, this major initiative will significantly influence University research and education. Units as diverse as the architecture department, the computer science and engineering department, the astronomy

department, and the University's library system are finding ways to collaborate and share knowledge to help Minnesota regain its digital edge.

As part of the initiative, the University established the Digital Technology Center (DTC), a new interdisciplinary facility that fosters computer-aided research. In early 2002 the center moved into state-of-the-art Walter Library, which had undergone a two-and-a-half-year, $63.4 million renovation.

The University will add 20 faculty positions in various areas of digital technology—14 funded with state money and six with internally reallocated funds. To date, 14 of these positions have been filled, including two founded in conjunction with the Carlson School of Management and several more based in IT. A $7 million grant from the ADC Foundation will endow five faculty chairs and eight graduate fellowships in the DTC.

The University named Andrew Odlyzko, former head of the mathematics and cryptography research department at AT&T Laboratories, as the center's first director. Odlyzko, who holds advanced degrees from California Institute of Technology and Massachusetts Institute of Technology, is also a professor of mathematics.

Christine Maziar, vice president for research and dean of the Graduate School, says of Odlyzko, "Andrew is an internationally known researcher. We recruited him aggressively because we knew he had the talent and expertise to recruit outstanding researchers to the center."

Although DTC research encompasses many disciplines, all projects will use vast amounts of data generated by modern research techniques. "We'll be working on very basic problems of how to deal with the tidal wave of information that all areas are trying to ride toward new discoveries," says Odlyzko.

The possibilities seem limitless. In fact, what attracted Odlyzko to the University was the opportunity to work with the vast range of technologies here.

It's a range that would astonish someone who thinks of computers as tools reserved for conventional scientific and technological research. But the DTC will be about much more than hard science, according to Odlyzko.

"The early uses of computers were for science, but as basic digital technology develops and becomes less expensive, it works its way down to the desktop level and to tiny microprocessors controlling our pacemakers or improving the performance of our car engines," he says. "It permeates society and enables us to find new and imaginative uses for technology."

For example, he says, digital technology makes it possible to meld totally disparate areas like the fine arts with science and engineering.

"We can give sculptors and artists new tools for designing, experimenting, and creating novel effects," he says. "The technology used to create [special effects for movies] may turn up on your kitchen wall as wallpaper with novel visual effects."

However, research in traditional areas like physics, electrical engineering, biology, and medicine are fundamental to the center's success. Existing facilities—like the Laboratory for Computational Science and Engineering (LCSE), which specializes in computer-generated graphics in areas of basic research—provide a prototype for the creative pairing of digital tools and pure science. The LCSE and the Minnesota Supercomputing Institute, which provides the high-performance computing infrastructure and support for all academic areas, will be integrated into the DTC to promote the center's interdisciplinary focus.

But the center can't accomplish its goals alone. Odlyzko emphasizes the importance of industrial and private-sector partnerships and calls the DTC "a bridge between the University and the industrial sector."

ONE RESEARCHER ABOUT TO cross that bridge is Assistant Professor Baoquan Chen of the computer science and engineering department, who maintains a gallery of eye-catching images on his web site. By far the most striking image is a plump, laughing Buddha splashed with what resembles red and blue paint. The Buddha provides a visual clue to Chen's work in computer graphics and visualization techniques.

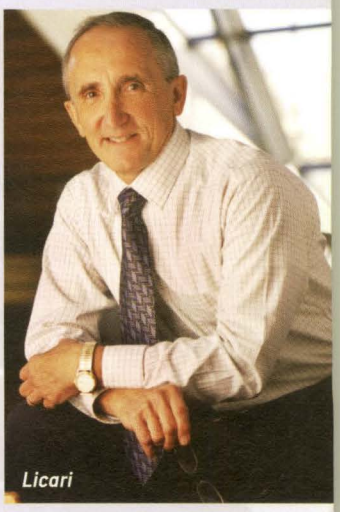
But the image also illustrates a working principle of Chen's career: effective presentation of results matters almost as much as the results themselves. He advises his students, "Structure your results to make a convincing and inspiring story."

A native of China, he joined the DTC in 2000, a year after receiving his Ph.D. in computer science from the State University of New York at Stony Brook. Of his own work, he says, "For any individual project, we have an image that best illustrates the underlying techniques."

In the case of the red-and-blue Buddha, those factors are speed and efficiency. "My

FORGING TIES TO INDUSTRY

TWO VETERANS OF THE CORPORATE WORLD ARE BRINGING their expertise and perspectives to the Digital Technology Center (DTC) to help it become a valuable emissary between the worlds of academia and industry.


Licari

Following a long career with IBM, Jim Licari (Aero '65, Mechanics Ph.D. '70) joined the DTC as assistant director for industrial liaison, fostering partnerships between DTC researchers and local and national companies. "The DTC will be the gateway to the University in areas of digital technology," says Licari. "Its strength will be that it acts as an umbrella, bringing researchers from various colleges and disciplines together."

Hal Ottesen, a professor of electrical and computer engineering at the University of Minnesota Rochester since 2000, is another IBM alumnus who really understands the importance of developing industrial/academic partnerships. He's built a successful career that embraces both arenas. After 32 years at IBM and 10 years as an adjunct professor of biomedical engineering at Mayo Graduate School in Rochester, he's bringing his insider's view of both worlds to the DTC, where he teaches courses in fuzzy logic, signal processing, and digital control.

Ottesen knows firsthand the creative challenges of technology transfer. "A problem might have been solved in a completely different field," he says. "I have taken solutions and methods that we used in disk drives and applied them to imaging problems that Ph.D. students at Mayo [Graduate School] are trying to solve. The challenge is the 'difficult problem' that no one has been able to solve. That's what I go for."

Licari and his colleagues are considering several different models for industrial/academic cooperation. "One thing we're considering is a DTC industrial affiliates program where we'd establish annual research and review meetings for member companies," he says. "We could have technical advisory teams and perhaps hold quarterly meetings for new technology input." Another possibility would be to develop one-on-one relationships in which individual companies work directly with DTC faculty to address specific research issues. Licari also would like to establish a discussion forum and exchange programs for corporate staff and University researchers.

"THE DTC WILL BE THE GATEWAY TO THE UNIVERSITY IN AREAS OF DIGITAL TECHNOLOGY. ITS STRENGTH WILL BE THAT IT ACTS AS AN UMBRELLA ... [FOR] VARIOUS COLLEGES AND DISCIPLINES."
—Jim Licari

Ottesen foresees a variety of partnerships that span many departments and disciplines. Some collaborations will foster commercialization of new innovations, a task the DTC can't accomplish single-handedly. The center plans to work with small companies and large established firms to convert DTC research into products that are profitable and useful in business relationships.

No matter what form the partnerships take, good communication will be a top priority. Potential corporate collaborators are reviewing the various partnership models. Before any final decisions are made, says Licari, "we need to get industry feedback."

Although it's too early to announce any formalized research partnerships, discussions are proceeding with industry representatives in the areas of computer graphics and visualization, genomic data mining, and high-performance computer data storage.

Ottesen's corporate experience has taught him that successful academic/industrial partnerships require a balance of pragmatism and theory.

"At IBM I was working in advanced technology, where you have to work not only on a theoretical level but you must also be able to implement your knowledge into practical working models," he says. "I know how corporations operate, how you have to justify the bottom line. You have a window of opportunity to get the product out the door. You have to have a plan—otherwise, things become academic." ■

research involves turning three-dimensional data into two-dimensional images," says Chen. "The general purpose is always to do fast and efficient rendering of images."

Traditionally, polygons form the basic surface images, called "primitives," from which computer graphics are constructed. But under certain circumstances, points can be rendered into images much more quickly than polygons. Therein lies the real significance of the virtual Buddha, whose blue splotches indicate polygons and whose red splotches represent points on the image's surface.

"We switch the primitives back and forth to speed up the rendering," says Chen. "If an object is close to the eye, we use polygons; farther away, we can use a few points."

The possibilities for applications that can render images quickly are wide-ranging. For example, Chen has worked on a project whose goal is to develop a "virtual colonoscopy," in which a CT scan of the human colon would replace the notoriously unpleasant medical procedure.

According to Chen, the technology is as easily adaptable to commercial purposes as to medical ones. He thinks the online shopping experience could benefit greatly from enhanced computer graphics.

"There are now virtual real-estate tours online. People aren't satisfied anymore with still images [of houses for sale]," he says. The virtual house tour would allow a prospective buyer to experience the sensation of "walking through" the property; however, the process still needs work.

"The challenge is in the speed [of the images]," says Chen. "Three-dimensional rendering is very costly. For this reason, the process is still not popular."

The technique that created the colorful Buddha is being used in an ongoing collaboration between Chen and Associate Professor Andrzej Piotrowski of the architecture department. They're using it to scan real-life outdoor environments, a process that generates huge amounts of data. Using Chen's technique, the researchers can manipulate the data more easily and integrate it with computer-generated design images. With the aid of this technique, architects someday may be able to conceptualize and portray their building designs amid the "real-life" environments in which the structures will be built.

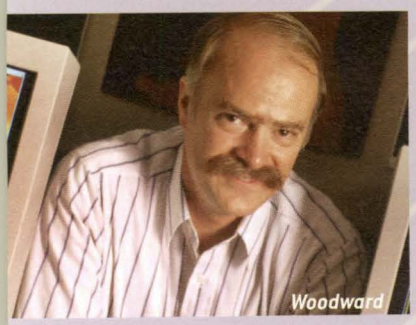
"Cross-disciplinary research is still the exception in architecture," says Piotrowski. "Our work to date has helped us realize how compatible our backgrounds are. Collaborative research creates a unique opportunity for both of us."

Chen and Piotrowski's project is supported by the University's new Digital Design Consortium, which brings together faculty from architecture, computer science, and other fields to develop computer-based design tools. Founded with a $1.5 million

VISUALIZING THE BIG PICTURE

THE DIGITAL TECHNOLOGY Center's industrial partnership program may be in its formative stages, but one of the center's own research groups offers a successful prototype for fruitful collaborations with industry.

The Laboratory for Computational Science and Engineering (LCSE) has had close connections with the computer industry for several years. The laboratory was founded in 1995 as a center for the development of numerical methods and techniques for high-performance computing in astrophysical fluid dynamics (the study of the motion of gases within stars). LCSE researchers develop techniques for the display of huge datasets in motion picture format.


Woodward

Says Paul Woodward, astronomy professor and LCSE director, "It's not enough to create one beautiful image from the data. You need to create thousands of such images at a time. We use hundreds of computers working in concert to generate this data, so it is natural to use dozens of machines to make a movie of the simulated fluid flow."

Woodward is quick to attribute the laboratory's success to mutually beneficial partnerships with industry. "The key is close collaboration with the computer industry," he says. "And the basis of our industry collaborations has been an exchange of what is easiest for each party to give and most valuable for the other party to receive. The industry contributes the hardware, and we contribute performance testing and demonstrations with real applications of interest to a broad community. We collaborate on system software."

One such partnership resulted in the development of the PowerWall, a display and image rendering system that LCSE built in partnership with computer manufacturers SGI and Ciprico. The system resembles a giant television screen on which films of computerized data displays are projected. In Walter Library this mammoth viewing area eventually will be equipped with five translucent walls standing nine feet high and extending more that 50 feet wide.

Unlike the more common video wall, which simply makes an image large, the PowerWall vastly increases the display resolution so that a huge amount of information can be viewed at a glance.

Both academic and industrial partners benefited from the PowerWall collaboration. "Within a year of developing it, we had an NSF grant to build a PowerWall at the LCSE, and we later won a U.S. Department of Energy grant to help its laboratories design and build PowerWalls," says Woodward. "SGI sold many systems of this type, particularly in the oil industry. They helped us build our own system with deep discounts and equipment loans."

The only disadvantage to working with industry is that it leads to some unusual professional contacts, according to Woodward.

"Not that many astronomers can say that they've shown their work at the annual meeting of the National Association of Broadcasters," he quips. ■

start-up grant from University alumni Ted and Linda Johnson, the consortium seeks to expand the possibilities of complex design modeling and to find new ways for architects and other practitioners to work with their clients in visualizing the design process.

CHEMISTRY PROFESSOR JIALI GAO strongly endorses that kind of interdisciplinary collaboration. He's one of the DTC faculty hired as part of the digital technology initiative, but his research also advances the University's initiative in the biological sciences.

A computational chemist, Gao investigates the structure and mechanisms of biomacromolecules, the super-sized molecules found in nucleic acids like DNA and RNA and in proteins. He uses techniques developed by computational chemists and computer scientists to model and access the large amounts of data stored in these biomacromolecules.

"To understand protein-protein interactions that we study, we need the techniques developed by computational chemists and computer scientists," says Gao. "The DTC is able to bring our disciplines together to create close collaborations."

Gao studies the role of enzymes and proteins in biochemical processes. Without the catalytic action of enzymes, chemical reactions would be too slow to be biologically effective. Proteins are highly specific and proficient in their actions, and each enzyme essentially recognizes only one molecule and catalyzes one reaction. A complex chemical reaction like metabolism requires a large number of individual catalytic reactions. To fully understand the driving forces behind these interactions requires sophisticated computer modeling techniques.

Gao explains, "Biochemists can carry out site-directed mutagenesis experiments by changing individual amino acids to see how they will affect the function of a particular protein, but experiments can't tell you everything. Theory is needed to understand the results in energetic terms."

And theoretical understanding requires computers.

"With computer modeling, we can build a realistic model of interactions between an enzyme and its substrate at the atomic level," he continues. "The computer model tells us why a reaction is faster and how specifically a transition state is stabilized in the protein environment. Computer simulations can model many, many transformations and derive a statistical average of the experimentally observable, such as the rate of the reaction."

"If we understand how enzymes work, we can apply the strategies adopted by enzymes to design chemical catalysts that can be effectively used in the synthesis of organic compounds and pharmaceutical drugs." —PROFESSOR JIALI GAO

But Gao's research isn't only a matter of understanding the basic processes that regulate human biology. Where enzymes are concerned, processes that can be understood also can be disabled, and that prospect generates real excitement in the world of pharmaceutical drug development.

Researchers know that tumor growth is associated with certain proteins. Pharmaceutical drugs are small, made-to-order molecules that inhibit the function of specific tumor-promoting proteins. "If we can block the function of those proteins, we may inhibit the growth of the tumor they accompany," says Gao.

Whether catalysis occurs during organic processes like metabolism or during inorganic procedures like the refining of gasoline, its basic chemical principles are similar, says Gao. "If we understand how enzymes work, we can apply the strategies adopted by enzymes to design chemical catalysts that can be effectively used in the synthesis of organic compounds and pharmaceutical drugs."

Gao, a naturalized U.S. citizen who was born in China, joined the University in 2000. He received his Ph.D. at Purdue University and did postdoctoral work at Harvard University. Before coming to Minnesota, he taught at the State University of New York at Buffalo for nine years.

Although he has participated in industry-funded research partnerships during his career, Gao stresses the importance of achieving a balance between academic and pragmatic objectives.

"Higher education should accommodate market needs," he says. "However, there are fundamental goals that cannot be driven by the market. We need to encourage students to pursue science and engineering."

Asked what he enjoys most about his work, Gao says, "I'm curious about why a protein is so specific, so efficient. Understanding it can help us cure diseases, but mostly I like to discover new things in nature—how nature works."

ASSISTANT PROFESSOR GEORGE Karypis is one of the computer scientists who develop tools to help researchers like Gao unravel nature's mysteries. "My job is to develop computational tools that can be used for research purposes by people in other disciplines," he says.

Karypis specializes in data mining, the science of developing computational tools that extract useful information from giant datasets. Data mining is frequently applied to commercial problems, such as inventory control or analysis of consumer buying habits. But Karypis wants to use data mining to help unravel the secrets of the human genome.

The Human Genome Project has identified the roughly 30,000 genes that carry the specific coding information for the functioning of all human organs and systems. The project is now investigating the approximately 100,000 proteins that carry out genetic instructions encoded in DNA molecules. Karypis is interested in modeling three-dimensional geometric structures of the proteins responsible for all phases of cellular structure and functioning.

"The 'Holy Grail' of research [in biology] now is going from protein sequences to 3-D structure," says Karypis. "One-dimensional information makes up the sequence of proteins [in DNA], but how are proteins involved in three-dimensional space? The basic premise [starts with] an existing database of structures that have been identified. For each of them, we know the amino acid sequence. Given these sequences, the problem is to predict the structure."

To do so, Karypis will try to identify and characterize relationships between proteins. Some proteins in the same structure could have different sequences, while other proteins might share sequences but have different structures. The first step, he says, is to build a model for sequences that are understood and then apply it to other sequences.

"My job is to develop computational tools that can be used for research purposes by people in other disciplines."

—ASSISTANT PROFESSOR GEORGE KARYPIS

To model the geometric relationships of proteins, researchers have also used X-ray crystallography and spectroscopy. But, says Karypis, "it takes a significant amount of money to find the structures of 100,000 proteins using these techniques. People have been trying to discover more economical methods to predict 3-D structure. We want to see if we can use data mining techniques that will be faster and less expensive."

Karypis, a native of Greece, came to Minnesota in 1988 to begin his freshman year at the University, where he also completed his graduate studies. In 1996 he received a Ph.D. in computer science and joined the computer science and engineering faculty.

Karypis' other research interest is the development of METIS, a sophisticated algorithm for high-performance computing. He named METIS after the mythological Titan who, had she not been eaten by Zeus, would have become the mother of Athena, goddess of wisdom. ("Remember, I'm from Greece!" jokes Karypis.)

METIS, which addresses the problem of efficient graph partitioning, is "a tool to find the best way to distribute a mesh among processors," according to Karypis. He's placed METIS in the public domain and distributes the algorithm free through the Internet.

"One of the advantages of making it free is that everybody can use it, and every single researcher out there does use it," says Karypis. "It gets downloaded 300 to 400 times a month. Distributing it that way gives me the opportunity to talk to people about it and foster additional research.

"It's also a great visibility tool, both personally and for the University," he adds. "Nobody can pronounce my name, but everyone knows how to say 'University of Minnesota.'"

Karypis also enjoys teaching and has coauthored a standard text entitled *Introduction to Parallel Computing*. Soon he'll begin teaching a new course in computational techniques for genomics, one of the first courses offered at the University in the hot new field of bioinformatics.

As far as Karypis and his DTC colleagues are concerned, "new" promises to be the watchword uniting all their efforts. Together with their industrial partners, they're determined to help Minnesota emerge once again as a giant of the Information Age. ■

FOR MORE ON THIS STORY, TURN TO PAGE 51

DESIGNING DIGITAL LIBRARIES

THANKS TO THE WONDERS of digital technology, today's students can carry the equivalent of a modest reference library in their backpacks and briefcases. The painful all-nighter may never become obsolete, but the laptop computer at least gives students their choice of venue. Now, as part of the University's digital technology initiative, virtual library resources are about to undergo a rapid expansion.

Walter Library is the locus of an effort to create a state-of-the-art digital library for science and engineering faculty and students. The new library will offer the same electronic access already available to all users, including many subject databases, but it will also feature many plug-and-play technologies that give laptop computer users maximum access to library resources.

However, University Libraries' role in the digital technology initiative extends far beyond the walls of Walter Library, says Digital Projects Librarian Chuck Thomas.

Some of the most exciting projects involve digitizing rare and unique materials within the University's special collections and archives. "We aren't reformatting all archived materials," Thomas explains, "but we are creating digital content from the things that no other university or archive holds."

University Libraries recently received a grant from the Institute of Museum and Library Services to support the digitization of 6,000 original World War I and World War II posters. University Libraries and the Minneapolis Public Library together will build an online database of all war posters owned by both institutions. Within two years, says Thomas, "they'll all be available on the Internet, screen-sized, searchable, and retrievable."

His staff already has digitized a collection of 2,100 theatrical backdrops produced by two Minneapolis companies in the early 20th century, thousands of historic photographs, and an assemblage of 4,000-year-old artifacts inscribed in cuneiform, the script of ancient Mesopotamia.

University Libraries also is a partner in numerous collaborations, including the Digital Asia Library (DAL) project, a virtual collection of resources on Asia created in cooperation with The Ohio State University Libraries and the University of Wisconsin-Madison Libraries.

Locally created databases and textual digital library content may not be as colorful as digitized images, but to the scholars who use them, they're indispensable. For example, anyone looking for data on chemical properties will appreciate a timesaving online tool created by the Science and Engineering Library staff. The Index of Chemical Properties database identifies the title and call number of the appropriate reference source.

The library staff must be increasingly proficient in many technical areas to assist researchers with the creation of electronic resources that support their individual objectives, says Thomas.

University Libraries is digitizing thousands of posters from World War I and World War II, including this one from 1914.

The Digital Collections Unit responds to a growing number of requests for help in designing and creating digital collections.

"The library specializes in describing and managing files so you know what they are and how to retrieve them. The Digital Collections Unit will be training faculty and others in how to create their own digital content in a way that promotes a digital library that is truly built and sustained by the entire campus," says Thomas.

A current major library initiative is the IMAGES gateway, a database of descriptive information gathered from digital imaging projects across campus. IMAGES permits users to search in one place for electronic content stored in many different locations.

Digitization of library resources presents unique challenges, among them the development of descriptive data for nonbook materials.

"Not everything that we offer access to is a book or an article," says Thomas. "The complexity of the descriptive data grows enormously, for example, when you have to document and manage interrelationships that are not nearly so obvious as they are for digitized series of books or periodicals."

Thomas believes the high-profile DTC can provide benchmark technological solutions that will benefit the library community nationwide.

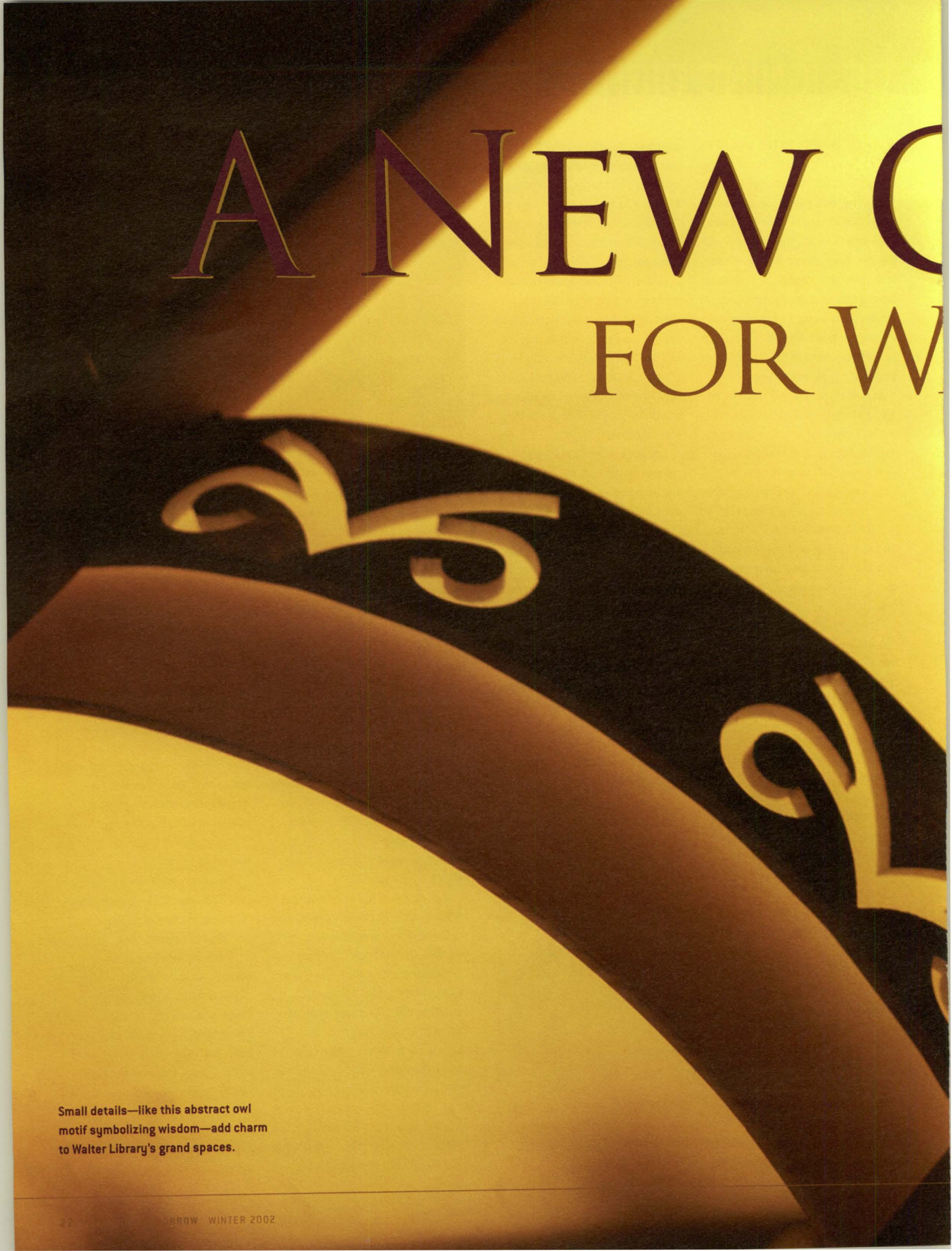
> "THE DTC IS UNLIKE ANY OTHER FACILITY IN ITS ABILITY TO FOCUS ON LARGE-SCALE, UNIVERSAL CHALLENGES OF CONSTRUCTING DIGITAL LIBRARIES."
>
> *—Chuck Thomas*

"Libraries are always having to reinvent the wheel at the local level," he says. "Often there aren't universal, flexible solutions or models that the library community can turn to. The DTC is unlike any other facility in its ability to focus on large-scale, universal challenges of constructing digital libraries. Its ability to attract funding and support is greater than any individual library."

The alliance between libraries and digital technology generates much excitement among Thomas and his colleagues.

"Working with library resources—especially archival materials—is always rewarding because you're working with something that's found nowhere else. You have the satisfaction of putting it out there on the web where thousands of other libraries and a global population can access it," he says. "You feel like you're making a positive contribution to a better future." ■

A NEW C
FOR W



Small details—like this abstract owl motif symbolizing wisdom—add charm to Walter Library's grand spaces.

CHAPTER
ALTER LIBRARY

EIGHTY YEARS AGO, state architect Clarence Johnston and University Librarian Frank Walter envisioned a state-of-the-art library whose classical design and stately interior would symbolize its scholarly mission. Their dream began to materialize in the blueprints that Johnston and three colleagues meticulously rendered with pen and ink on 28 sheets of fine linen. Johnston's design incorporated the latest architectural features of the day, and when the new University Library opened on October 31, 1924, it earned universal praise for its elegance and modern technology. (The general library building was renamed Walter Library in 1959 to honor the influential head librarian who transformed the University system into

BY MARY COONS

PATRICK O'LEARY

one of the country's major research libraries.)

Changing times, poor facilities, and surging demand for University library services had prompted the Minnesota legislature in 1919 to appropriate $1.25 million for a new library. Now a $63.4 million renovation has restored the 78-year-old Classical Revival structure to its original glory while refashioning it into a high-tech showcase for research and education.


Walter Library under construction in 1923

The University's Academic Initiatives

University officials concluded in 1989 that Walter Library needed major renovation. Although it had been a modern-day wonder in 1924, the library could no longer meet the needs of students and faculty in the high-tech Information Age. The structure itself didn't comply with current health and safety standards; its most worrisome defect was a major fire hazard—the library's 12-story steel-frame stack core. In addition, librarians warned that an environment without air-conditioning and humidity controls jeopardized long-term preservation of the library's vast collection.

According to a plan conceived in 1989, a renovated Walter Library would house the Science and Engineering Library, the Education/Psychology Library, and IT Administration. That same year the state legislature appropriated architectural design funds, and the University moved quickly into the project's initial phase.

The project continued through the normal course of schematic and design development until 1992, when the initial phase was 90 percent complete. In 1994, due to a shift in the University's capital request strategy, the Minnesota Library Access Center (later renamed the Elmer L. Andersen Library) replaced the Walter renovation on the University's list of priority projects. Andersen Library received design funds in 1994 and construction funds in 1996.

The Walter project quietly slipped into limbo until 1997, when Mark Yudof became University president and quickly proclaimed his goal of making the University one of the nation's top five public research institutions. Yudof's vision encompasses major academic initiatives, a capital plan to support those initiatives, and a commitment to historic preservation.

Yudof and other University leaders envisioned a renovated Walter Library that would embody these ambitious objectives. Their proposal allocated about half of the building's space to the new Digital Technology Center (DTC), locus of the University's digital technology initiative. A hub of research and education, the center would also form alliances with business, industry, government, and other educational institutions to help secure Minnesota's leadership in digital and information technologies.

"Mr. Yudof understood the scope of the project as well as the resulting benefits to both industry and education," explains Drew Bjorklund of Stageberg Beyer Sachs

WALTER LIBRARY TIMELINE

1919 The Minnesota legislature approves $1.25 million for a main University Library building.

1921 Construction begins.

1924 Construction is completed. Building opens with a dedication ceremony on October 31.

1959 The main library building is renamed in honor of University Librarian Frank Kellogg Walter.

1989 State legislature appropriates architectural design funds for a major renovation of Walter Library; schematic and design development begins.

1992 Schematic and design development of the Walter project is 90 percent complete.


Main reading room under construction in 1923

1994 Minnesota Library Access Center (Elmer L. Andersen Library) replaces the Walter Library renovation on the University's list of priority projects.

1997 President Mark Yudof proposes major academic initiatives and a capital plan that will transform Walter Library into a state-of-the-art library and digital technology center.

1998 The Minnesota legislature approves $53.6 million for the Walter Library renovation, and design development begins.

1999 Walter Library tenants relocate to temporary quarters, and construction begins.

2002 Walter Library renovation and restoration is completed; building is rededicated.

COURTESY UNIVERSITY ARCHIVES [3]

The main reading room in the 1940s

(SBS), project architect. "By incorporating a digital technology center, this would strengthen the University's role in future digital technology advances."

The center would be housed in one of the most historically and architecturally significant buildings on the Twin Cities campus. But for generations of alumni and faculty, the library also created indelible personal memories of their years on campus. Walter Library was the incubator for scholarly research, intellectual growth, eleventh-hour term papers, and furtive socializing. Navigating its stacks alone at night was an ill-advised venture for the claustrophobe or anyone with an overactive imagination. Newcomers and regular patrons alike responded to the library's grand scale and its classical beauty. Even the most casual students felt a bit more scholarly as they ascended the wide Tennessee marble staircase leading to the second-floor atrium and the stacks.

The Walter Library project was included in the University's 1998 capital request to the state legislature. The library's proposed

For generations of alumni and faculty, Walter Library created indelible personal memories of their years on campus. It was the incubator for scholarly research, intellectual growth, eleventh-hour term papers, and furtive socializing.

reincarnation—a potent synthesis of farsighted goals, pragmatism, history, and collective memory—persuaded legislators to allocate $53.6 million to transform the University landmark into a 21st-century library and digital technology center.

The Major Players

With funding secured, the next step was to select an architectural firm. The State Designer Selection Board uses a qualification-based selection process to choose primary designers for state agency construction projects, including University projects whose estimated construction budget exceeds $2 million.

SBS, a Minneapolis architectural firm, received the library project commission in 1990 along with Davis Brody Associates, a New York City architectural practice with expertise in historical renovation. However, SBS became the sole project architect for the revamped program in 1998.

"We were selected partly for our work done in the past," says Bjorklund. "We had designed the Southdale and Brookdale regional libraries [in suburban Minneapolis], the University Aquatic Center, [and] several campus parking ramps. We have a solid working relationship with the University, and we understand libraries."

Still, he admits, the project was daunting. The renovation was mapped by 450 sheets of computer-generated drawings, a far cry from Johnston's hand-drawn blueprints.

"We've done small-scale historical restoration projects previously, but this was the largest renovation project Stageberg Beyer Sachs has attempted," Bjorklund says. "It was a unique project because

of the complexity of the program and adapting the existing building to a new use."

Construction began in 1999 after building tenants relocated to temporary quarters elsewhere on campus. Bjorklund spent about half his work time on-site, mediating between practicability and the dictates of historical preservation. General contractor M.A. Mortenson Company of Minneapolis and officials from University Facilities Management supervised the project and coordinated the work being done by a team of nearly 20 firms.

CHALLENGES AND CONSTRAINTS

Given the library's historical and architectural significance, renovation was the only way to address the building's deficiencies and to meet programmatic goals, according to SBS's preliminary design report.

The complex project would have to transform a 78-year-old structure into a state-of-the-art, computer-serviced instruction and research facility that complied with current building codes. The design plan called for a dramatic excision—removal of the 12-story stack core—to create "new space" for an addition that would promote safe egress and house library and DTC facilities. Moreover, the project had to maintain a delicate balance between renovation and historic preservation.

"Balancing building code criteria with historic preservation guidelines is a delicate process, especially if it means altering the structure's historic presence," says Bjorklund. "When you're involved with a historic structure, you must be sensitive to the preservation quality of the building and its historical significance. In this situation, where we created an addition, the design had to complement the original building. We strove to make no changes in its historical character."

The removal of the 12-story stack core left a gaping hole in the library's west side, as seen here in December 2000. A new addition replaced the stack core.

The project required a dizzying range of expertise: in engineering specialties, electrical and mechanical systems, telecommunications, plaster and drywall, masonry, fireproofing, sprinkler systems, plumbing and heating, roofing, lighting, ornamental metal, and restoration.

The team's collective skills faced multiple challenges. Crews had to contend with several different structural systems, coordinate new construction with the original, and assess the relative cost-benefits of historic preservation and reproduction.

Obsolescence and energy inefficiency were major problems; all plumbing, ductwork, lighting, and electrical systems had to be replaced. The windows, originally made of steel and cast-iron elements, have been replicated with new aluminum castings and thermal-break aluminum sashes. The library's stately exterior also needed attention. But the most pressing concerns involved health, safety, and accessibility.

The steel-frame stack core presented the most serious safety problem. A major fire hazard, the stack core couldn't be fireproofed because it was open to all floors; a

BLENDING THE OLD WITH THE NEW

The new addition had to maintain the library's historic character and complement the original building. Compare the west exterior now (far right) with the original in April 2000 (far left). The middle photos show the same view in October 2000 and June 2001.

COURTESY UNIVERSITY OF MINNESOTA FACILITIES MANAGEMENT (5)

fire that originated in the stacks could have spread quickly throughout the building. This situation, aggravated by inadequate emergency exits, substandard alarms, and a poor emergency lighting system, would almost have guaranteed loss of life and property.

Workers remodeled an existing elevator with a new cab, installed three additional passenger elevators and a new freight elevator, and added emergency egress stair towers. An entrance on Pleasant Street SE provides access to the facility for people with disabilities. The building now is universally accessible except for mechanical spaces and electrical closets, says Bjorklund.

Workers also fireproofed existing clay masonry walls, removed asbestos, upgraded fire-safety equipment, added air-conditioning and humidity controls, and brought electrical, mechanical, and plumbing systems up to code.

Technology for the New Century

The Science and Engineering Library—another major tenant—will work with the DTC to create a digital library and to become a national leader in electronic information. To meet those objectives, the building includes facilities for state-of-the-art electronic storage and delivery systems, made available by stacked systems closets (vertical runs) and access floors (horizontal runs).

The DTC's 48,000 square feet of access floors conceal miles of optical fibers and copper wiring that transport data and power underneath surface flooring. DTC space includes classrooms dedicated to the development of computer-aided undergraduate courses, workspace for collaborative ventures, distance-learning classrooms, and advanced networking, computing, and telecommunications laboratories.

Existing programs relocating to the DTC include the Minnesota Supercomputing Institute, the Laboratory for Computational Science and Engineering, Academic and Distributed Computing Services, the Learning Resources Center, and the Digital Media Center.

INA FIRKINS: LIBRARIAN, SCHOLAR, BIBLIOGRAPHER

WALTER LIBRARY'S GUIDING LIGHT

LIKE A TREASURED family heirloom on display, a small glass-enclosed consultation room adorns Walter Library's splendid main reading room. When the library opened in 1924, that charming nook was an exalted space. Here, reference librarian Ina Firkins kept watch over a collection that she had tended and cultivated since 1889.

Brilliant, talented, and resourceful, Firkins was born in 1866 and graduated from the University in 1888 with a bachelor's degree in literature. Back then, teaching was one of the few professions open to women, but it didn't appeal to Firkins. When University Librarian William Folwell offered her a job as a library assistant in 1889, she quickly accepted it.

The only library science training she received was a one-sentence directive from Folwell, who handed her an official appointment paper along with the key to the library and said, "Open up the library in the morning, Miss Ina, and remember that if anyone has to get mad in the library, let it be the person on the other side of the counter."

"With that rule and some common sense a girl could make her way in a library those days," Firkins told a newspaper reporter in 1932, the year she retired. And that's exactly what she did, becoming one of the most scholarly librarians of her time, a well-known bibliographer, and a "link between the old University and the new," as the University Senate described her in a posthumous tribute.

INA FIRKINS SUPERVISED THE CONSTRUCTION OF WALTER LIBRARY, PLANNED ITS FURNISHINGS, ORGANIZED ITS STAFF, AND COORDINATED THE TRANSFER OF BOOKS FROM THE OLD LIBRARY (BURTON HALL) TO THE NEW BUILDING.

During her 42-year career, the library increased its collection from 25,000 volumes to half a million. No other library staff member knew the collection as comprehensively as Firkins did, so it's no surprise that the University chose her to shepherd the construction of Walter Library during a critical time of transition.

University Librarian William Gerould resigned in 1920 to take a similar position at Princeton University, shortly after the board of regents approved the preparation of plans for a new library. Firkins was appointed Acting Librarian, a temporary position she held until Frank Walter became University Librarian in September 1921.

"Many felt that [Firkins] should have been appointed chief librarian, but the traditions of a University are hard to overcome," wrote Gratia Countryman, head of the Minneapolis Public Library from 1904 to 1936, in a memorial tribute to her friend.

With her vast knowledge of the library, Firkins would prove to be an invaluable administrator and a resource for the librarian-elect. She supervised the construction of Walter Library, planned its furnishings, organized its staff, and coordinated the transfer of books from the old library (Burton Hall) to the new building.

Over the years, she served thousands of students, many of whom were a little afraid of her. Tall and dignified, wearing a rather austere black dress with a white collar, Firkins could stifle giggly socializing with her favorite disciplinary device—a few sharp taps of a pencil on her desktop.

Despite her stern professional demeanor, in her private life Firkins was noted for her sparkling sense of humor, spontaneity, and lively personality. She was active in professional and cultural organizations and managed a five-person household. She died while vacationing on a cruise near Norway in 1937. ■

COURTESY UNIVERSITY ARCHIVES

The remainder of the building provides office space for library staff, IT Administration, and DTC core faculty, research staff, and students. The building's tenants began moving into their new quarters in December, but the process will take several months to complete.

PRESERVING THE PAST

Eligible as a historic property, although not included in the National Register of Historic Places, Walter Library is rich in architectural detail and symbolism.

Previous efforts at modernizing the library during the 1950s and 1960s eliminated some of its historic character. The original art deco lighting was replaced with utilitarian fluorescent fixtures, and several coats of paint covered some of the hand-painted, multicolor detailing of the plaster ceilings. Fortunately, the current renovation was planned during a period of strong local and national support for historic preservation.

According to the National Historic Preservation Program, "historic properties are now understood and appreciated as part of the landscape to which they belong."

All public construction projects require a one percent designation of funds for art, says Bjorklund. "In keeping with the overall art theme on the campus and to maintain the original budget for the [library's] ceiling restoration, the ceilings were identified as the 'art' of the building project. The board of regents determines how this money is spent. In the face of budget cuts, the regents felt that this budget needed to be maintained and allocated art funds for the ceiling restoration."

He adds, "Our greatest interest is in preserving what was originally here and adapting that facility to the 21st century."

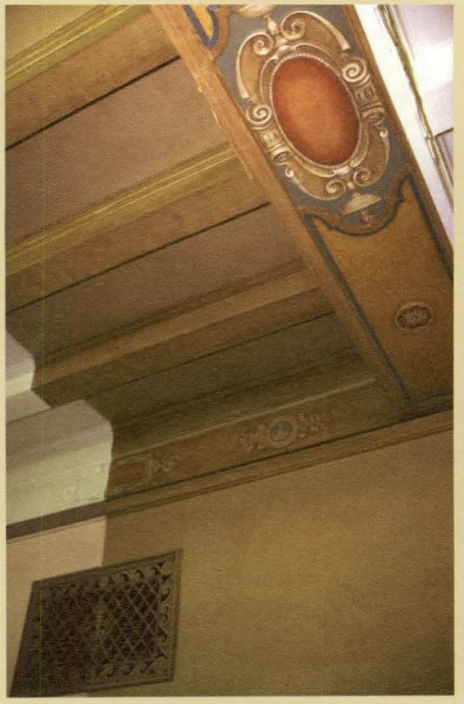
Ironically, it has taken modern technology, materials, and know-how to return the library to its former splendor. But the same spirit that inspired the library's design and construction guided its current restoration.

"It's been a labor of love on all our parts," says Bjorklund. "The construction program has created a facility that the departments, designers, trades workers, and end-users will be very proud of and can enjoy for decades to come." ■

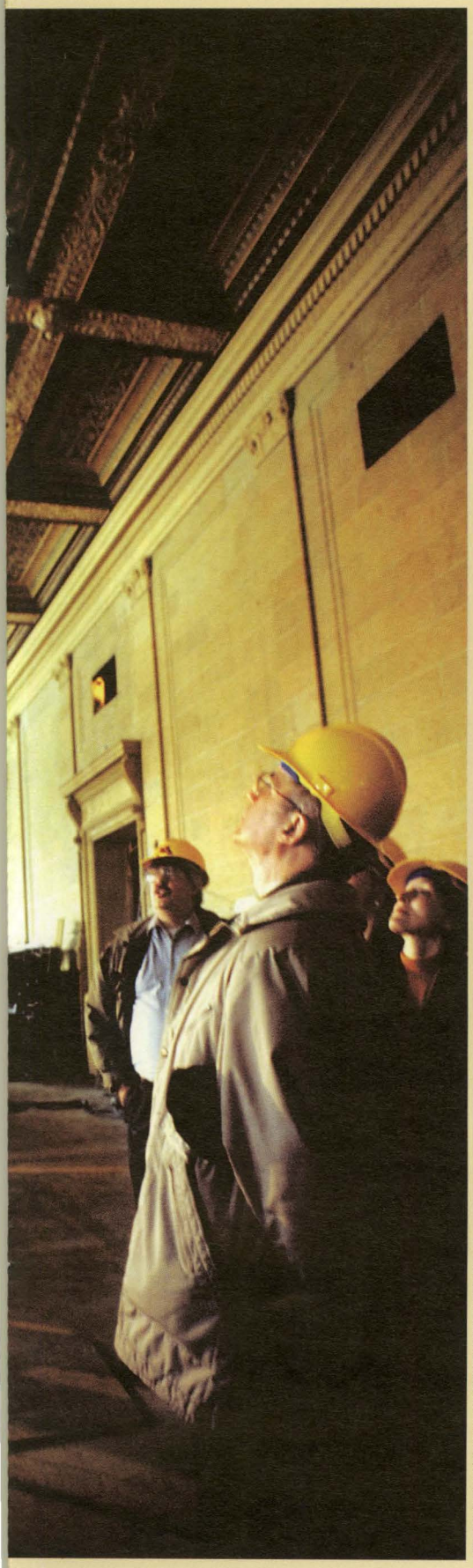
FOR MORE ON THIS STORY, TURN TO PAGE 51

Facilities Management representative Chuck Koncker (left) describes the restoration process to Digital Technology Center director Andrew Odlyzko (foreground) and IT staff during a tour of the library's main reading room. Compare the ceiling's appearance in this photo with the final results shown on pages 38 and 40.

THE DELICATE ART OF RESTORATION



Layers of dust, grime, soapy film, and paint obscured the vibrant beauty of the library's ornamental plaster ceilings. Skilled artisans spent thousands of hours cleaning and restoring the ceilings to match their original appearance. Above: A test strip reveals the luminous color of the Learning Resources Center's ceiling. Right: Layers of paint concealed the original decorative scheme in the ADCS computer lab. After removing the paint, artists worked painstakingly to match the original color palette of warm neutrals and pastels.



LEFT: SCOTT ROMSA (3); RIGHT: COURTESY UNIVERSITY ARCHIVES

THE UNIVERSITY'S PASSIONATE POET

ARTHUR UPSON'S LITERARY LEGACY

"I LOVE THE RAINY day, the quiet room, the books, the pictures and the glowing fire," lyric poet and dramatist Arthur Upson (1877-1908) once wrote to a friend.

Acclaimed for its purity of form, Upson's poetry often expressed a strong passion for the beauties of nature. His death at age 31 cut short a literary career filled with such promise that many contemporary critics predicted he would become one of the leading poets of his time.

Upson and his family moved to Minnesota from New York in 1894, and he entered the University with the class of 1898. He struggled with poor health most of his adult life and was unable to complete the requirements for a degree. However, in 1906 the University awarded him one anyway after the publication of one of his volumes of distinguished poetry. *The Bellman*, a small but influential literary magazine of the early 1900s, was one of the first periodicals to publish his work.

As a student, Upson wrote the second verse to "Hail! Minnesota," a song composed by Truman Rickard that would become the University hymn and later the official state song. Upson's stanza reflects his love of Minnesota's natural beauty:

Like the stream that bends to sea / Like the pine that seeks the blue / Minnesota still for thee / Thy sons are strong and true. From their woods and waters fair / From their prairies waving far / At thy call they throng / With their shout and song / Hailing thee their Northern Star.

In 1906 he became a lecturer in the English department, teaching through a year when he was never well. Two years later, Upson drowned while boating alone on Lake Bemidji in northern Minnesota, where he had gone to finish a verse play while on vacation.

Upson's friends collected and published two volumes of his works posthumously, and when Walter Library opened in 1924, his friend Ruth Shepard Phelps led the effort to establish and furnish a reading room in his memory. Phelps, author and professor of Romance languages, had met Upson through a mutual literary club affiliation.

When the Arthur Upson Room formally opened on February 21, 1925, University Librarian Frank Walter accepted its book collection on behalf of the University. In his speech Walter said, "Some rare spirits can cultivate immunity to confusion and can enjoy sweet solitude in the middle of a crowd. Most of us are incapable of such concentration. An air of quiet and ease and beauty in the place where books are read are great aids to almost everyone. To this purpose this room is dedicated."

The reading room, bestowed to the University three years later, is funded through an endowed trust. ■

The Arthur Upson Room in the 1930s

A Treasure

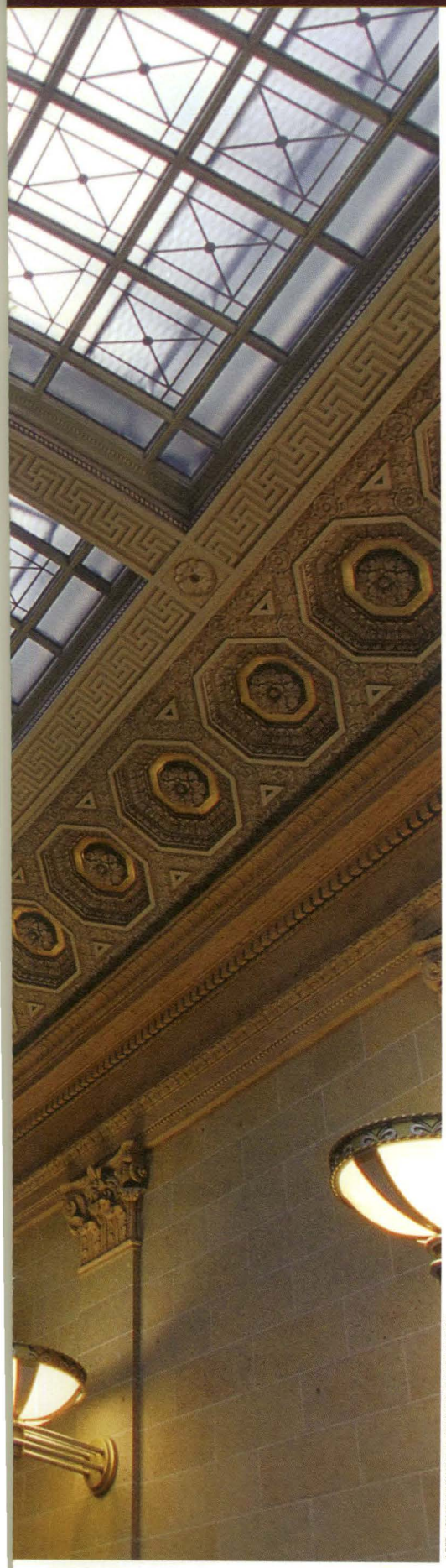
A Visual Tour O

RESTORED
F WALTER LIBRARY

Treasure Restored

A Visual Tour of Walter Library

The Great Hall

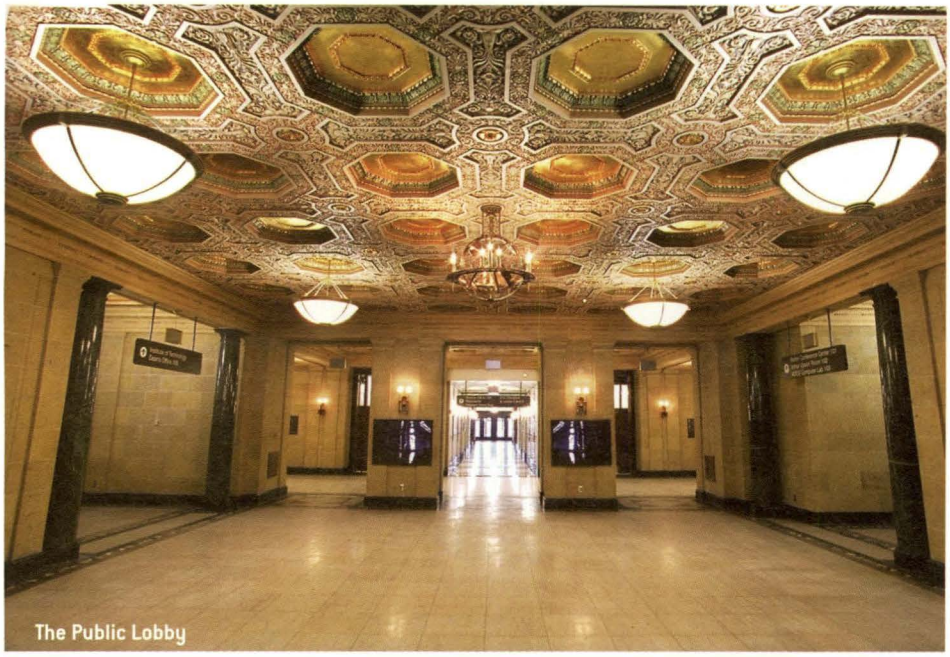


LEFT: JONATHAN CHAPMAN; PREVIOUS: PATRICK O'LEARY

WHEN THE UNIVERSITY'S NEW high-tech library opened in 1924, architect Clarence Johnston called it "the fruition of years of planning, of research, of study by many minds to give the University a great building." Nearly 80 years later, his pithy appraisal also characterizes a two-and-a-half-year, $63.4 million renovation of the campus landmark. In January 2002, Walter Library—a remarkable synthesis of old and new—reopened its doors to the University community. The many minds—and skilled hands—involved in this undertaking include University president Mark Yudof, the board of regents, University librarians, facilities management officials, faculty and staff, state legislators, architects, a general contractor, and workers from nearly 20 companies. From the project's beginning, those involved worked to maintain a balance between historical preservation and modernization. For example, says architect Drew Bjorklund, all lighting had to be stripped and replaced with new systems, so project designers scoured old photographs and

TEXT BY MARY COONS

PHOTOGRAPHS BY JONATHAN CHAPMAN AND PATRICK O'LEARY


The Public Lobby

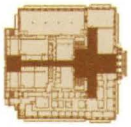
documents for clues to the building's original appearance.

"Based on early photographs, we designed fixtures to complement the originals yet not duplicate them," explains Bjorklund. Specialty fixtures were sized and lamped according to each room's requirements.

That meticulous care and aesthetic is reflected throughout Walter Library, a restored treasure that exalts the human spirit.

THE FIRST FLOOR

Materials, color, and lighting suffuse the building's interior with a warm, inviting glow. Even its most expansive spaces feel intimate and tranquil.



THE PUBLIC LOBBY: The ornamental plaster ceiling in earth tones of terra cotta, blue, green, and beige, accentuated with gold leaf, complements the lobby walls of warm-toned Mankato Travertine limestone and the Tennessee Pink marble floors. Deep-hued Green Alps marble columns frame the entrance to the north-south corridor that leads to the IT dean's office and to the ADCS undergraduate computing lab.

Restoration of the ornamental plaster ceiling with its octagonal recessed coffers accounted for most of the lobby work. Workers removed decades-old dust and soapy film that dulled the ornate ceiling and obscured other exquisite details.

Conrad Schmitt Studios (CSS) of New Berlin, Wisconsin, painstakingly restored the ceiling to its original beauty. Over a one-year period, CSS artisans spent more than 18,000 man-hours restoring the library's polychromatic ceilings and decorative plaster details at the cornice-line.

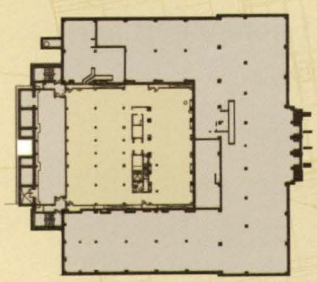
Wherever possible, workers repaired and repainted original plaster designs. Certain areas demanded more aggressive techniques—removal, recasting, and repainting—to achieve the desired results. Artists sat on scaffolding for hours at a time carefully applying color to the ceiling panels with delicate brush strokes. The skillful restoration makes it nearly impossible to detect panel "seams" or the sprinkler heads camouflaged inside plaster details.

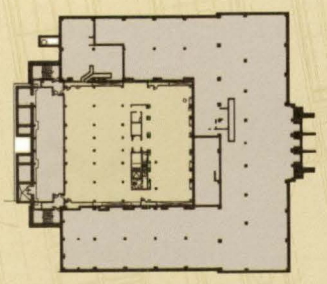
Visitors will enjoy a pleasant stroll along the spacious east-west corridor that connects the main lobby to the building's entrance on Pleasant Street SE. Crews salvaged inch-thick rosy-beige stone panels from the original stack core floors and recycled them as cladding for the corridor walls. Glossy black marble accents, a fabric-covered arched white ceiling, and ambient lighting all add a touch of sleek sophistication to this high-tech zone.

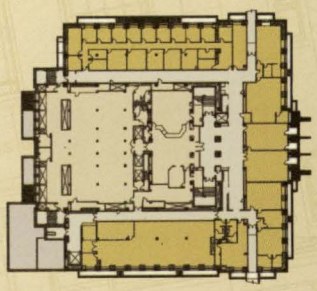

JONATHAN CHAPMAN (3)

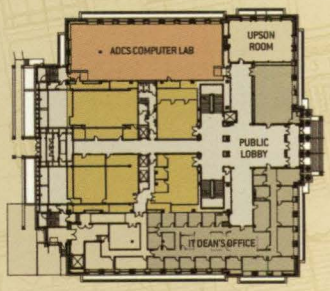
Several DTC facilities—the PowerWall and com-

WALTER LIBRARY: THE NEW FLOOR PLAN


FOUNDATION

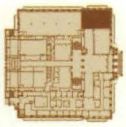

SUBBASEMENT


BASEMENT



FIRST FLOOR

puter laboratories for graphic design, graphics and visualization, and interoperability—are now located where the first-floor stacks once stood. Entrances to the interoperability lab and graphic design lab (formerly a library service area) retain their decorative bronze gate grilles, whose clever design incorporates fish and owl figures, symbols of knowledge and wisdom. New doors behind the gates replace the originals.



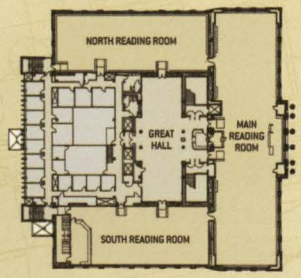
THE ARTHUR UPSON ROOM: Off the lobby to the north, a corridor leads to the Arthur Upson Room. Tucked away in the building's northeast corner, this quiet retreat is a memorial to the young poet who wrote lyrics to "Hail! Minnesota."

The Upson Room opened in February 1925 as a reading room for undergraduates. The room's dark, opulent furnishings and ornate interior reflected Upson's taste for Italian Renaissance furniture and rich decor.

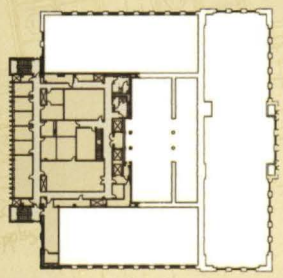
Decades ago, the limestone mantle fireplace, framed by rich mahogany and cherry woodwork, radiated the warmth of a crackling fire on chilly winter days. Overhead, polished oak beams and ceiling panels are adorned with stenciled and hand-painted designs, including symbols of the zodiac. CSS artists preserved the original ceiling artwork and "in-filled" areas of loss. Winona Lighting restored the room's two wood-and-brass chandeliers, whose blue, gold, and burnt orange palette accents the ceiling artwork.

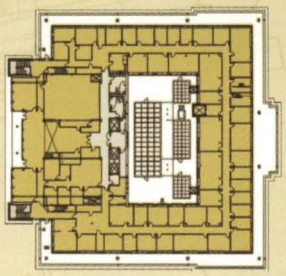
The Arthur Upson Room

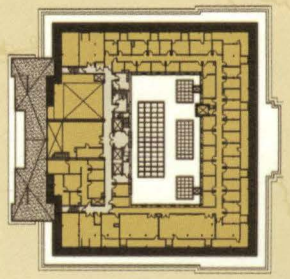
KEY: ADCS COMPUTER LAB · CORRIDORS & PUBLIC SPACES · DIGITAL MEDIA CENTER · DIGITAL TECHNOLOGY CENTER · IT ADMINISTRATION · MECHANICAL · SCIENCE & ENGINEERING LIBRARY



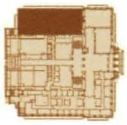
SECOND FLOOR


THIRD FLOOR


FOURTH FLOOR


FIFTH FLOOR

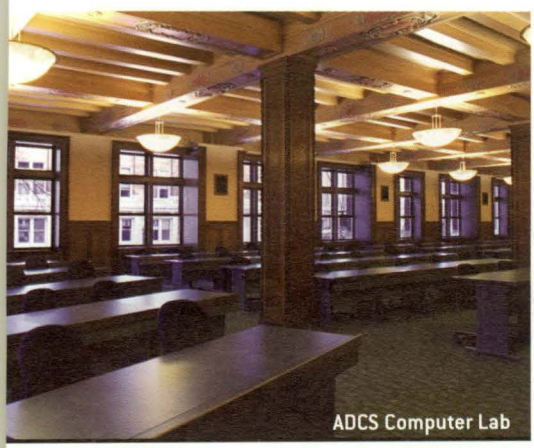
CSS repaired and restored the room's exquisitely painted wall surface of composition cardboard, which is lightly embossed to simulate leather and held in place by large brass buttons. New vinyl composition tile in olive brown and tan replicated the original British flooring pattern of dark and light squares, a style popular during the late 19th century.



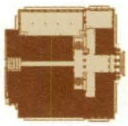
OLD RESERVE READING ROOM: The original north reading room adjoining the Upson Room is now a spacious Academic and Distributed Computing Services (ADCS) computer laboratory open to all University undergraduates. The lab accommodates about 100 workstations.

Workers built a carpeted, raised subfloor four inches over the room's original linotile flooring. Inside this space they threaded a complex network of data and power cables. This configuration will give technicians easy access to the wiring when changes are required.

Oak wainscoting and a splendid decorative plaster ceiling with honey-colored beams add ambience and charm to this high-tech space. In areas where the original decorative scheme had been painted over, workers removed layers of white paint one at a time to uncover the original color scheme of warm neutrals and pastels. Artists painstakingly experimented with blending, glazing, and application techniques until they achieved a six-color palette that matched the original in color, tone, value, hue, and application.



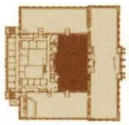
ADCS Computer Lab



OTHER AREAS: The IT dean's office occupies its refurbished quarters in the library's south wing. The remainder of the first-floor is used for offices, conference rooms, and study lounges.

THE SECOND FLOOR

Between walls lined with sand-colored Kasota limestone, two monumental Tennessee marble staircases with turned marble balustrades ascend to the second floor. At the top of the stairs, Green Alps marble columns divide the atrium from the Great Hall, where a massive stone reference desk once guarded the entrance to the stacks. A smaller version of that desk, created with panels salvaged from the original, was moved to its current location in the atrium. Stone artisans from Europe modified the panels to fit the new design.



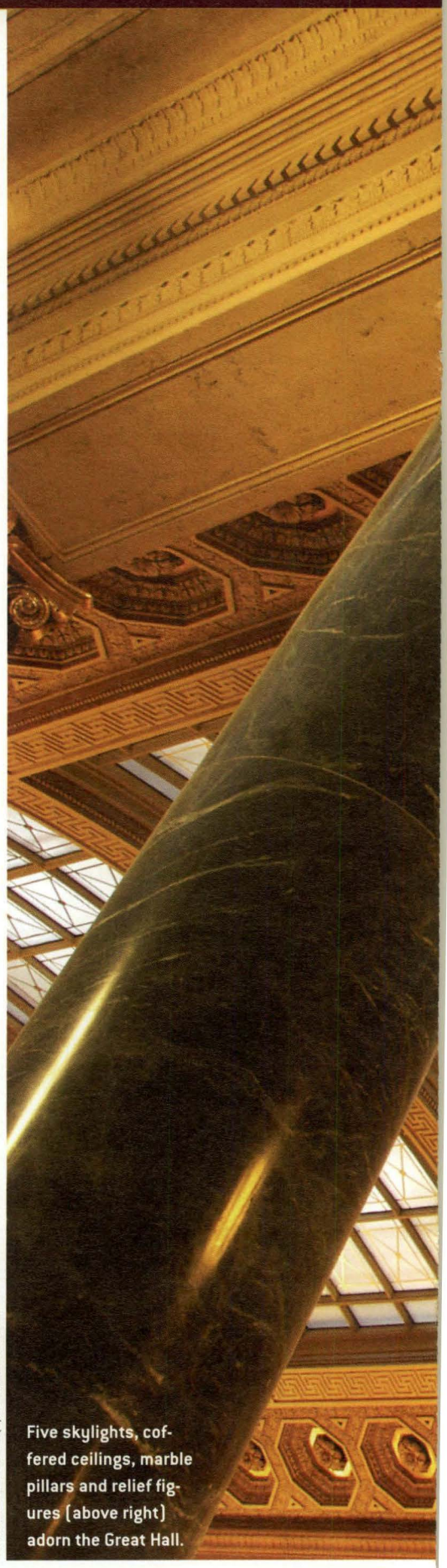
THE GREAT HALL: A jaw-dropping expanse of five skylights sweeps across the Great Hall ceiling (three smaller skylights overlook the atrium).

"Building codes have very strict rules regarding overhead glass," says Bjorklund. "From a restoration standpoint, the preferred choice would have been to keep the originals, but to meet code compliance, they had to go. New lay-light panels were crafted to meet building code requirements and yet maintain the character of the original glass."

CSS artisans used Glasslam, a clear silicone/epoxy mixture, to bond patterned art glass to heat-strengthened glass. Faux caming was bonded to the underside (down side) of the glass panels, replicating the original caming patterns.

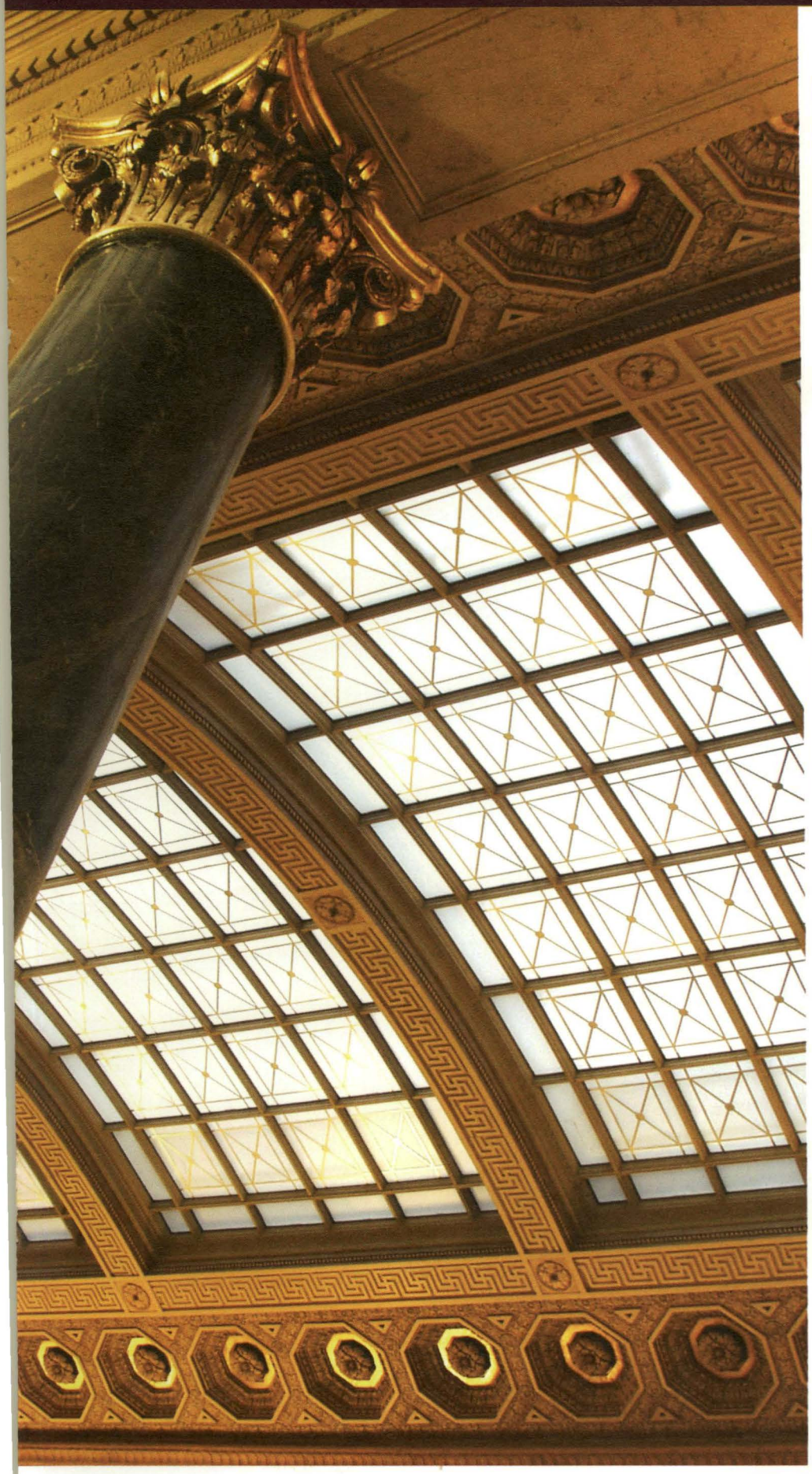
Ceilings of the Great Hall and atrium needed extensive plaster repairs and restorative painting. After removing loose paint and dirt, artisans washed the areas thoroughly and lightly sanded them to prepare for painting. They experimented with blending, glazing, and application techniques on sample boards until they could match the original look. Finally, they applied tinted primers and base paint.

To be furnished with soft, cushy chairs, the Great Hall is a stately yet inviting set-



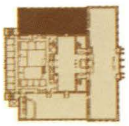
LEFT: JONATHAN CHAPMAN (2); RIGHT: PATRICK O'LEARY

Five skylights, coffered ceilings, marble pillars and relief figures (above right) adorn the Great Hall.

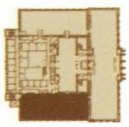


ting for study, relaxation, or contemplation. Wall sconces and table lamps provide task and ambient lighting.

The Great Hall is also the gateway to three magnificent reading rooms that house Science and Engineering Library facilities and the Learning Resources Center. Sculptured marble lunettes crown the doorways leading into the north and south rooms; their relief figures symbolize Industry, Agriculture, Science, Law, Power, and Wisdom. Ancient printers' marks and cameos of notable cultural and scientific figures are carved into the doorjambs.



NORTH READING ROOM: This spacious room boasts yet another beautifully restored ceiling. A trompe l'oeil ("fool the eye") technique known as wood graining creates the illusion of varnished wood trim. The molded plaster ornamentation received a richly colored glaze to accent the detail. The room is furnished with large study tables, carrels, and new library shelving over an access floor. The reconditioned original oak tables are fitted with new task lighting and outlets for access to power and data.



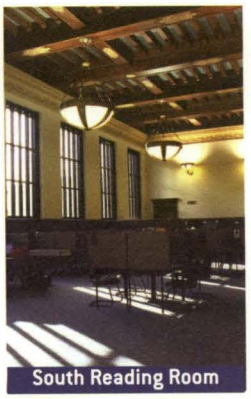
SOUTH READING ROOM: For several decades this former reading room—same in size as the north reading room—was closed to the public and used as library office space. It's now the Learning Resources Center, where students and faculty access University Libraries' nonbook materials, primarily audio recordings and videotapes. This collection covers the scope of University instruction but emphasizes the

Main Reading Room

JONATHAN CHAPMAN (2)

humanities and social sciences.

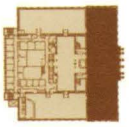
Only the room's shell—its windows, double doors with oval windows, ornate ceiling, and wainscoted walls—maintains the feel of a traditional library. Furnishings include hexagonal carrels and one-person workstations where students search the Internet and use the library's video and audio resources.



South Reading Room

The ornamental plaster ceiling alternates faux wooden beams in walnut tones with panels of deep aqua blue. A decorative painted border in warm pastel hues encircles the top of the walls.

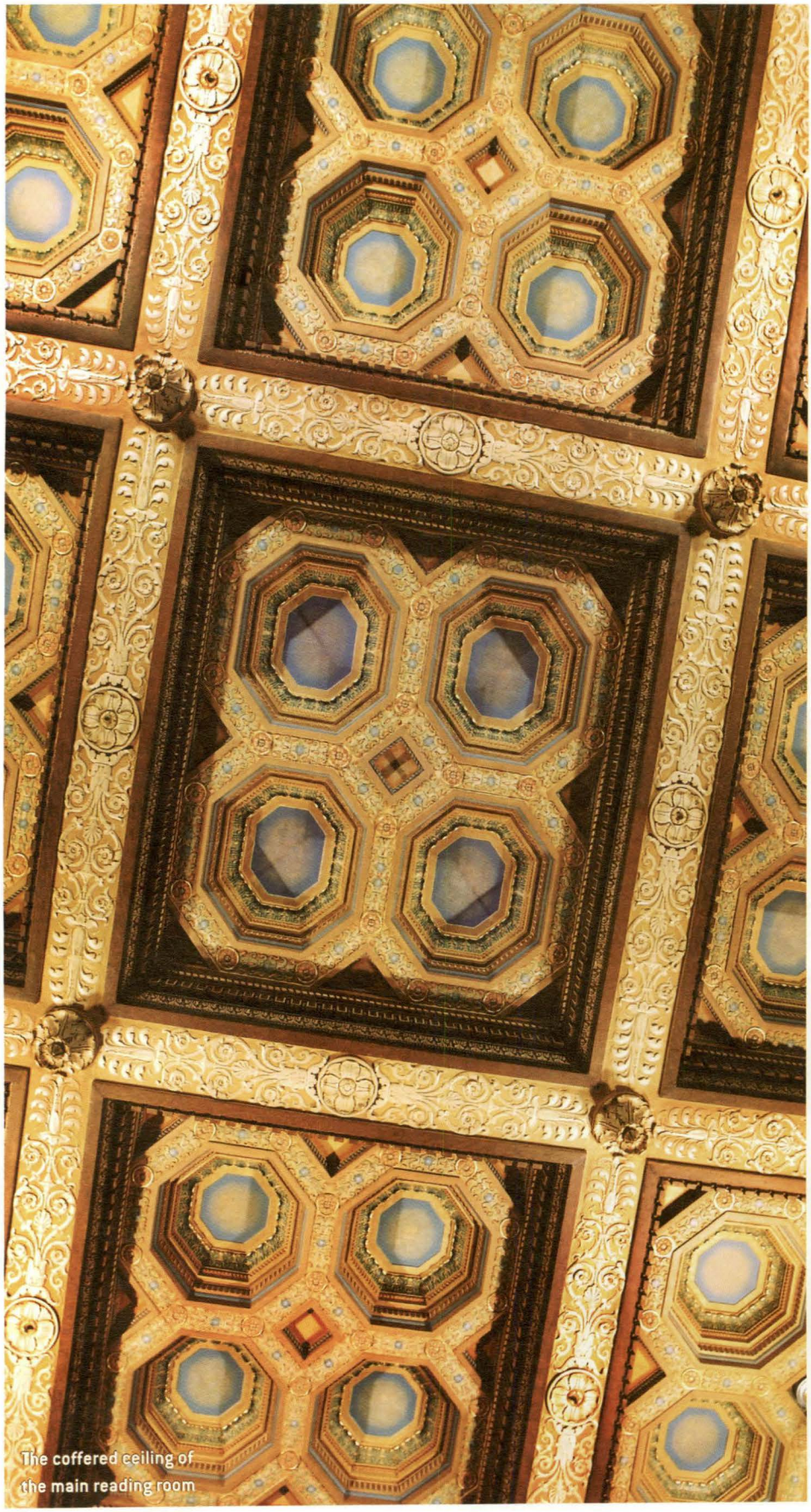
Along the south wall a series of decorative bronze grilles bearing the library's recurring owl motif conceals the room's heating system. Like other utilitarian fixtures throughout the library, they're designed to please the eye and blend into the decor.



MAIN READING ROOM: Measuring 52 feet wide by 200 feet long, the magnificent main reading room spans the second floor's east side. Resurrecting the beauty of this room was an architect's dream.

Here, more than in any other room, the eye is drawn upward—to the expanse of windows on three sides, to 16 massive bowl-shaped light fixtures suspended from the 22-foot-high ceiling, and to the ornate plaster ceiling itself. A pattern of squares—four recessed coffers per square—blankets the ceiling like an elegant heirloom quilt. Rendered in dominant hues of rose, aqua, antique ivory, and soft green, the ceiling is accentuated with gold leaf.

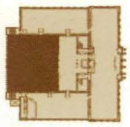
Built-in oak bookshelves five feet high line the room's perimeter. Above the bookshelves a border of stone cladding adds texture and visual interest. The room's original wooden tables, which collectively accommodate over 240 people, were removed, sanded, repaired, and reinstalled.



The coffered ceiling of the main reading room

Each table is equipped with new task lighting atop a wooden base containing data and power connections.

A small, elegant reference consultation room of polished wood and glass—part of the original decor—graces the west wall. After extensive research using original documents and old photos, the project architect designed a new reference desk, located along the opposite wall, which incorporates Johnston's original panel designs.



NEW WING: From the Great Hall, visitors can enter the new west wing, which houses the Digital Media Center (DMC). Charged with promoting the effective use of learning technologies, the DMC supports faculty who use these technologies to improve teaching and learning. Facilities include a classroom, audio lab, video editing area, media center, and offices.

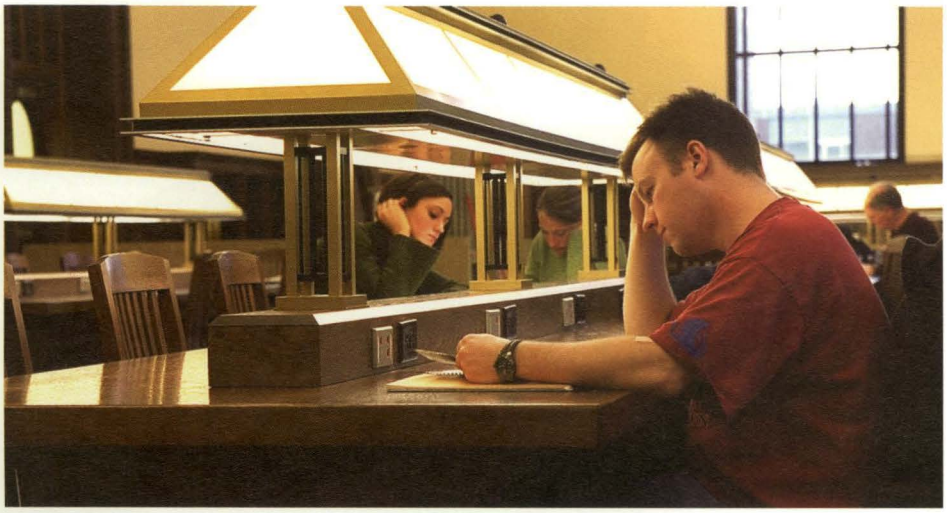
UPPER FLOORS

Strictly speaking, Walter Library lacked a third floor until the new wing was added. The second-floor reading rooms, Great Hall, and atrium—which stand two stories tall—wrap around the third-floor addition, which is roughly one-fourth the size of the other floors. The area is reserved for library offices and workspaces.

The fourth and fifth floors house the DTC's administrative office and other digital technology tenants, including the Minnesota Supercomputing Institute and the Laboratory for Computational Science and Engineering.

The fourth-floor commons area offers a spectacular view of the downtown Minneapolis skyline to the west. Ceiling light fixtures add an art deco flavor to the space, which is sure to become a favorite gathering spot for DTC faculty, staff, and visitors. Just off the commons area are two conference rooms and a spacious scientific presentation center. The remainder of the floor contains offices and workstations.

The fifth floor includes a small commons area, a digital instruction classroom, digital laboratory, offices, and mechanical areas.



Oak tables equipped with task lighting, electrical outlets, and data jacks make the north reading room an accommodating place to study.

Lower Floors

The once-drab basement level underwent an amazing transformation. Gone are the old typewriter workstations, the cramped archives area, and the old reserve room.

The Science and Engineering Library's main circulation/reserve desk area, which occupies the basement core, features new library stacks and comfortable study areas. Oak panels, carpeting, and recessed lighting add visual texture and warmth to the circulation desk area.

The north-south corridor still connects Walter Library to the University's tunnel system, but a gallery of high-tech facilities replaces the archives office and student computer lab along the passageway. DTC facilities here include a parallel/distributed computing laboratory, visualization and networking laboratories, a robotics laboratory, and offices for faculty and students.

The bulk of the Science and Engineering Library's collection is stored in the building's three underground floors—the basement and two lower levels. The subbasement consists of a core section of library stacks and small reading areas surrounded by a U-shaped ring of mechanical rooms. The foundation level contains library stacks and reading areas.

Exterior Façade

The project maintained Walter Library's historic exterior of Bedford limestone and brick masonry. For the west side, where the new wing replaces the stack core, architects designed a stone, brick, and brass exterior that blends beautifully with the original structure.

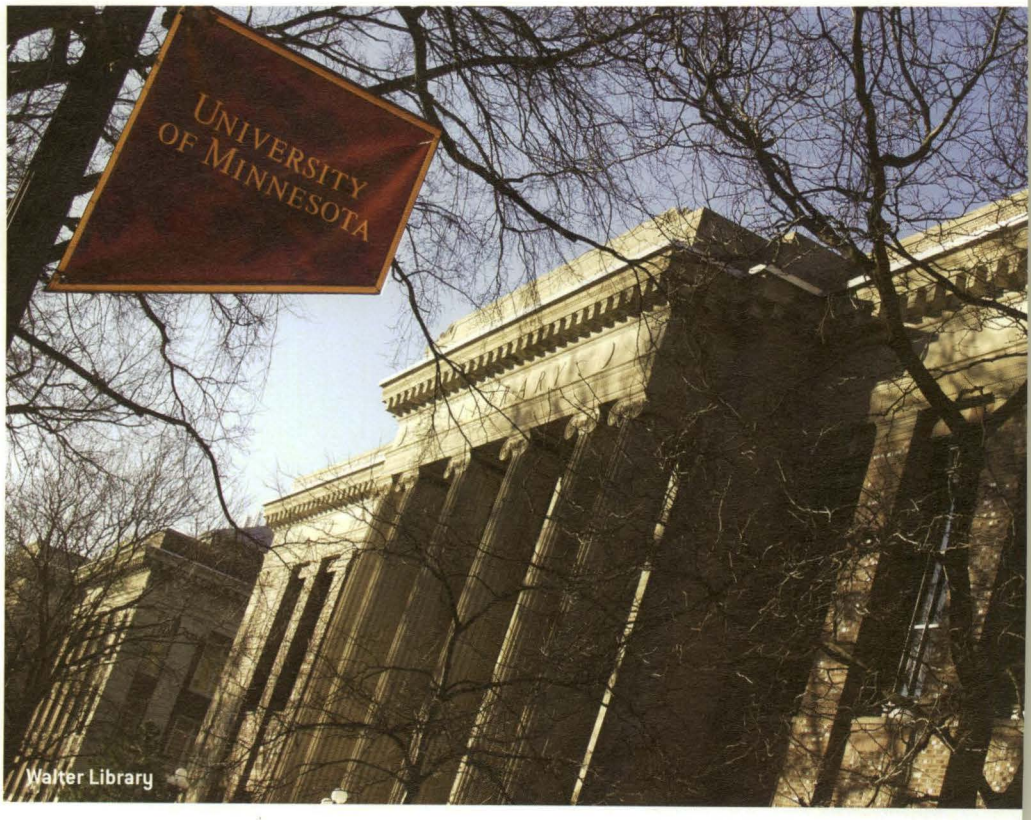
A colonnaded portico facing Northrop Mall marks the building's main entrance. Relief panels—surmounted over three doorways framed in carved stone—needed only a light touch-up. Like so many of the building's architectural details, the sculptured panels are richly symbolic, here representing various aspects of a liberal education. The center panel, which portrays elements from the Seal of the University, is supported by the youthful figures Light and Wisdom.

The right panel features Greek male and female shapes representing Power, Ambition, Study, Abundance, Inspiration, and the child Education.

On the left panel, a group of figures—the female figure Wisdom and male and female figures symbolizing Geography, History, Inspiration, Work, and Music—tend to a small child bearing the laurel leaves of Attainment.

The twin decorative bronze pedestal lamps mounted on the buttresses of the front steps were surveyed for damage, stripped, and cleaned. To complement the style of other mall buildings, each lamp received four new globes, and new brass handrails adorn the ornamental main doors. ■

FOR MORE ON THIS STORY, TURN TO PAGE 51



Walter Library

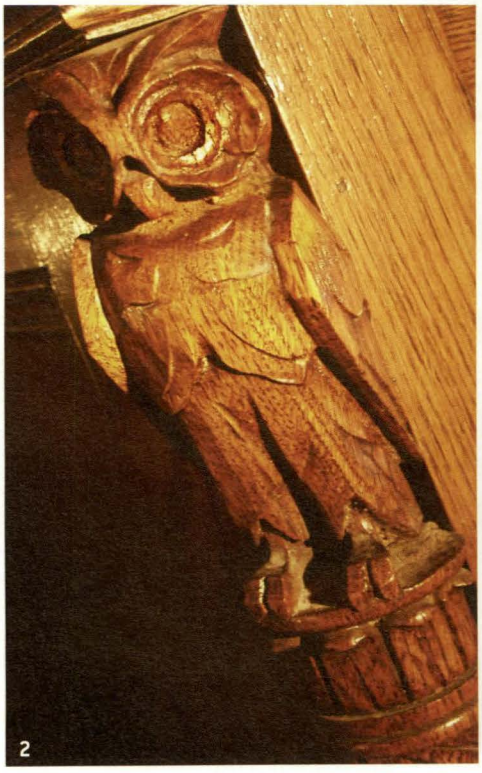
TOP: JONATHAN CHAPMAN; BOTTOM: PATRICK O'LEARY

HIDDEN TALONS


1

KEEN-EYED VISITORS will spot the charming owl figures that adorn various architectural and design details in Walter Library, often in unexpected places. Symbols of wisdom, the owls grace moldings, columns, and grillwork in the building's historic spaces. In total, more than a dozen different types of owls—from straightforward sculptures to abstract designs—perch among the books and mortar. The renovation added several more, including a stylized owl motif on second-floor light fixtures and chandeliers.

PHOTOGRAPHS BY PATRICK O'LEARY


2


3

4

OWL BE SEEING YOU

Here's where you'll find some of our favorite fowl roosting in Walter Library: 1) Carved in limestone atop doorjambs in the public lobby. 2) Carved in oak pillars in the ADCS computing lab. 3) Wrought in decorative bronze gate grilles in the public lobby. 4) Encircling the elegant chandeliers in all three reading rooms. 5) Alongside the figure Law in the marble relief over the door from the Great Hall to the south reading room. 6) Wrought in decorative bronze grills covering heat registers in the south reading room. 7) Carved in limestone atop doorjambs in the Great Hall. 8) Carved in the limestone cladding of the main reading room.

5

6

7

8

Alumni Ted and Linda Johnson seize the chance to expand the frontiers of digital design BY NICHOL NELSON

Window OF OPPORTUN

IN THE LATE 1960S, computers didn't talk, they didn't play games, and they certainly didn't fit on your lap. The world was not yet exposed to *Tomb Raider*, jewel-toned iMacs, or email. But Ted Johnson, a seventh-grader in a small Minneapolis suburb, had vision. ■ At an age when most kids ponder the complexity of first crushes and Four Square, Johnson taught himself the basics of computer programming. He embraced the future of technology while most of the world dismissed the hulking, beeping machines as complex calculators. Johnson, who has always possessed the ability to see into the future of technology, has created groundbreaking software, creative workplace tools, and a new University consortium.

Although he remained interested in computers throughout his high school years, Johnson resembled fictional architect Howard Roark more than Bill Gates when he enrolled at the University in 1975. The Columbia Heights native wasn't convinced he could make an exciting career in front of the screen.

"My perception was that all work with computers was data processing," Johnson says with a chuckle. "It didn't sound very interesting."

Relegating computer work to a hobby, Johnson chose architecture as his major. He completed three years of the program and would likely be altering skylines today were it not for a split-second lapse of judgment. While visiting his girlfriend (and future wife), Linda Gerth, in her dorm room, on a whim Johnson decided to leap from her window. The display of male bravado netted him a broken ankle.

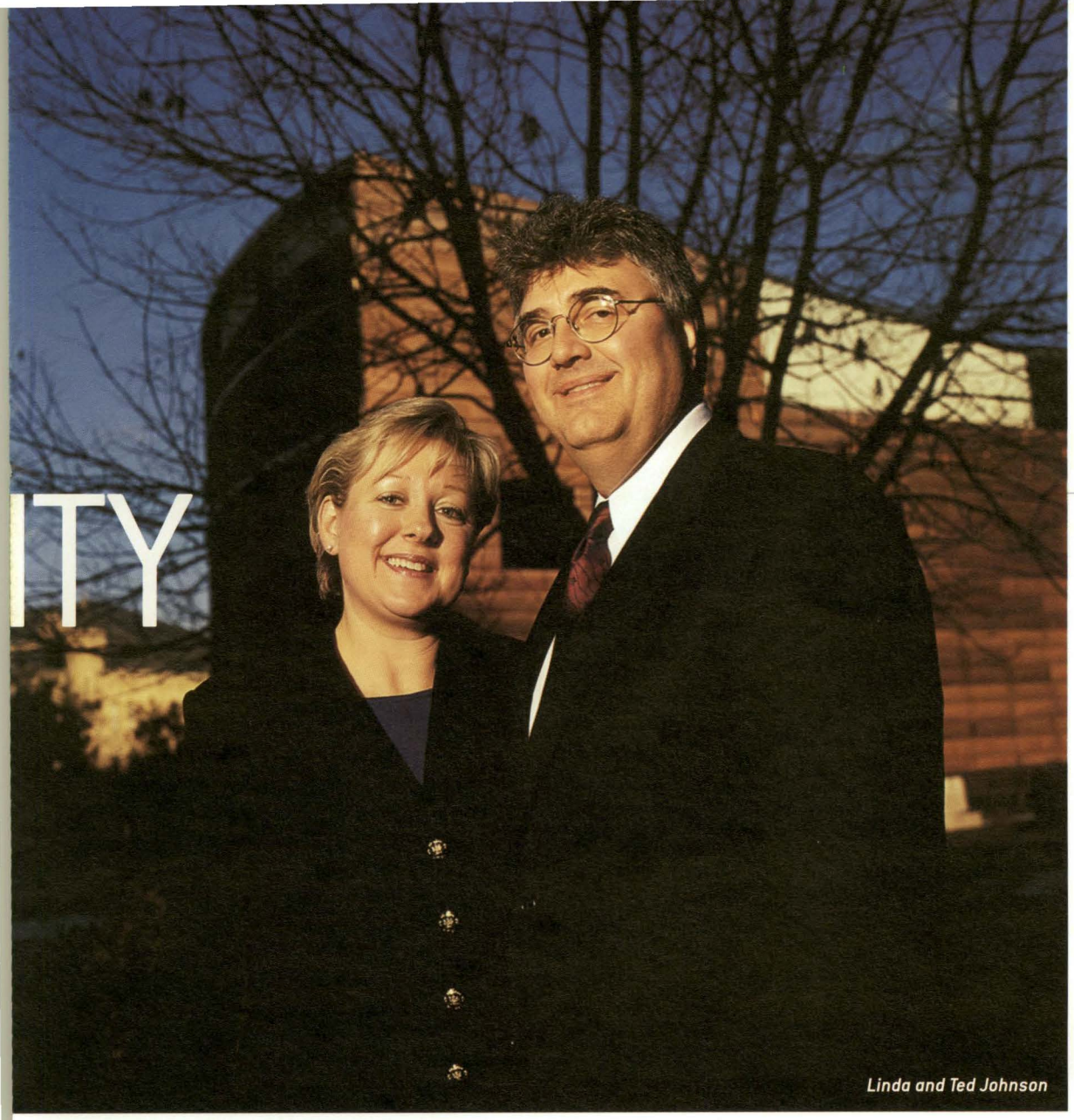
The injury had far-reaching consequences. Hobbled by a thick cast, Johnson was forced to quit his part-time job loading packages for UPS and search for another source of income. "Lifting boxes just wasn't feasible with a cast," he says matter-of-factly.

His life changed course when he accepted a part-time job monitoring a new computer network for the Minneapolis *Star Tribune*. "[That job] turned me on to the whole idea of computers as a career," he says.

The network, called Atex, connected reporters and editors via a paper-free system. Installed in 1977, Atex allowed writers to work on-screen instead of using cumbersome electric typewriters. The system—basically a series of crude terminals connected to one main server—proved enormously popular with the newspaper's staff and management.

In the pre-PC era, the system completely changed the way reporters and editors wrote, permitting them to rework and rewrite without the burden of retyping entire articles. (Incredibly, a version of the system remains at the *Star Tribune* more than 20 years later.)

Initially, Johnson's duties in the newly formed text processing department didn't require much technical skill. "Basically, we were there to restart



Linda and Ted Johnson

[the computers] if they crashed," he says only half-jokingly. True to form, however, Johnson became extremely involved in his work.

"It was the first time I considered computers as tools in the workplace," he says.

Johnson began teaching himself the Atex system. Using obscure source code, he puzzled out the inner workings of the glowing green terminals and became an in-house expert.

In 1978, his supervisors at the *Star Tribune* offered him a full-time job as a computer programmer, and Johnson accepted, putting his academic progress on hold.

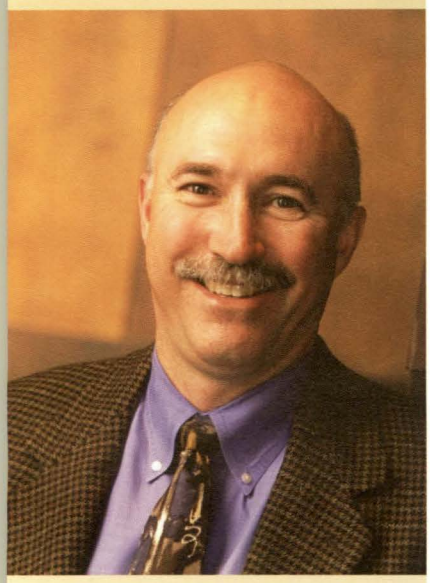
It didn't take long for a new career direction to emerge. In 1980 Atex appointed him head of its news layout system. That same year Johnson resumed his University course work, changing his major to computer science. His goal: to design technology that simplified the workplace.

In 1982, he completed a bachelor's degree in computer science. After graduation Johnson and his wife, Linda, relocated to Boston, where he worked for Atex in systems maintenance. Linda—the economics major whose dorm room had provided the all-important window of opportunity—accepted a job in finance.

The early 1980s saw a number of eye-popping developments in computer technology, including the introduction of the IBM personal computer in 1981. Eager to get involved with the revolution, Johnson and four colleagues left Atex in fall 1983 to start a corporation focused on developing a PC-based word processing system.

The venture was successful but temporary. An intriguing opportunity soon arose in the person of Paul Brainerd, a former *Star Tribune* colleague. The debut of the Apple Macintosh computer in 1984 created a major buzz in the PC world, where users coveted the

SEE **OPPORTUNITY**, PAGE 50 ▶



Our alumni and friends foresee a bright future for IT and want to help make that vision a reality.

The past year's accomplishments fuel our optimism and remind us that bold dreams come true

Blueprint for success

UNLIKE POPPING CHAMPAGNE CORKS and warbling "Auld Lang Syne," the purchase of a new calendar is a seldom-noted year-end ritual. Most of us cross it off our December to-do list with hardly a second thought. "Out with the old, in with the new," we quip, replacing the outdated appointment book filler or removing the calendar from the wall.

Still, we pause to browse through the calendar's pages—a smudged, coffee-stained archive of the year's accomplishments. We remember our hard work, and all the goals we've fulfilled because of it. Our satisfaction and gratitude inspire hopes for the year to come.

My 2001 calendar documents a year of extraordinary accomplishment for the University and IT. The number of first-year students who have chosen the University and IT has increased substantially, and we are attracting students who are better qualified. Academic and faculty research productivity is high, and every measure of technology transfer activity is up. The University ranks third among the nation's top public research universities, according to a study published in August by The Center for Studies in the Humanities and Social Sciences at the University of Florida.

CAMPAIGN MINNESOTA
UNIVERSITY OF MINNESOTA

By any standard, IT's alumni and friends have been extremely generous. To date, IT has received more than 11,000 donations during Campaign Minnesota. Over 300 donors have given gifts of $25,000 or more. Seventy-six percent of the donors are alumni, and almost 200 faculty and staff have made gifts. Only 8 percent of the donors are corporations.

Of the $105 million raised during the campaign so far, $43 million was raised from July 1, 1996, to June 30, 1999, and $62 million has been raised over the last two and a half years. The college's endowment has increased by more than $63 million in current and future gifts, and new bequests to IT total more than $26 million.

I am an optimist by nature, but those figures reinforce my expectation that we will raise $55 million during the next 18 months—the amount we need to reach our Campaign Minnesota goal of $160 million. Last year's appointment book also reminds me of the many wonderful people I've met who are committed to the college and its mission. Not only do our alumni and friends foresee a bright future for IT, they also want to help us make that vision a reality.

The collective experience and enthusiasm of our development team—Paul Allison, Steve Biever, Jennifer Clarke, and Tom Kinsey—are the other key ingredients that fuel my optimism. They believe so strongly in what IT does.

As I said, I am an optimist. I know that in June 2003—if not earlier—we will celebrate the successful conclusion of Campaign Minnesota. My 2002 appointment book is both a blueprint I'll use to reach that goal and a reminder that bold dreams do come true. ■

HELPING STUDENTS LIVE AND LEARN

FOR MOST STUDENTS, THE FIRST year of college is an exciting and challenging time of enormous change. Last fall, IT and the University's Office of Housing and Residential Life began a new program designed to make that transition easier, thanks in part to a generous gift from Mrs. George Taylor, a longtime IT benefactor.

Taylor's gift launched the Explorations in Engineering and Sciences House, where IT freshmen live and learn in a community setting. Students enrolled in the program live together in a block of rooms in Centennial Hall and take courses together. They also participate in special educational, social, and developmental programming that's designed to broaden their horizons and ensure their academic success.

"Students and parents really love this program," says Susan Kubitschek, who coordinates the program for IT Student Affairs. "It makes the University less scary and gives students a real sense of community. Those things, in turn, support [students'] academic achievement."

Explorations in Engineering and Sciences House is one of 21 new subject-based living and learning communities available to first-year students at the University. Others focus on disciplines from art and design to biology and foreign languages.

The enhanced programming makes living and learning communities more expensive than traditional dormitory housing, says Kubitschek. Students who participate pay higher housing fees to cover part of the cost; the remainder comes from private sources.

"Mrs. Taylor's gift really made it possible to get this program off the ground," says Kubitschek. "Now that we know the program is a success, we're looking for ways to serve more students."

IT CAMPAIGN WATCH

$105 MILLION

As of February 1, 2002, IT has raised more than 85 percent of its $160 million Campaign Minnesota goal. Overall, the University has raised nearly $1.2 billion during the first three years of the campaign. Thank you, alumni and friends, for your generous support.

BUYING MORE BOOKS

A GENEROUS GIFT FROM HAROLD Conrad (ME '41) and his wife, Phyllis, ensures that the bookshelves in Walter Library will be a little more crowded. Their contribution is the first to a new $200,000 IT library endowment that will eventually fund the purchase of 100 new books each year.

Although library funding has remained constant over the past several years, most science and engineering journals have raised their subscription rates dramatically, forcing University Libraries to drastically reduce the number of titles it purchases.

The library endowment is designed to reverse that trend, says IT dean H. Ted Davis. The income it generates will supplement existing funding for the science and engineering collection, allowing the library to purchase additional titles for IT departments.

"This endowment will go a long way toward ensuring that our faculty and students have the library resources they need," says Davis. "Thanks to the Conrads, we're off to an auspicious start."

DEVELOPMENT OFFICE

Office of Development
Institute of Technology
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

development@it.umn.edu
www.it.umn.edu/giving
612-624-5527
800-587-3884

Development Team

Phil Oswald
612-626-9385
poswald@it.umn.edu
- development director
- mechanical engineering

Paul Allison
612-625-6035
allison@it.umn.edu
- aerospace engineering
- chemistry
- student affairs

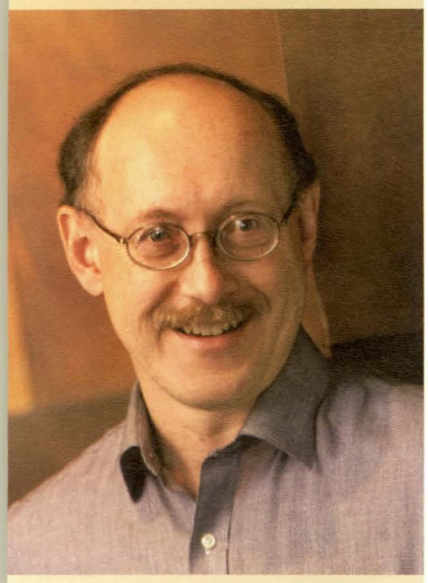
Steve Biever
612-626-9501
sbiever@it.umn.edu
- chem. eng. & mat. science
- geology & geophysics
- physics

Jennifer Clarke
612-626-9354
jclarke@it.umn.edu
- astronomy
- civil engineering
- computer science

Tom Kinsey
612-625-4509
tkinsey@it.umn.edu
- biomedical engineering
- electrical & computer eng.
- mathematics

TO MAKE A GIFT

To support a project you've read about in *Inventing Tomorrow* or to designate a gift for any purpose, you may contact a development officer directly or call 1-800-587-3884 for more information.



ITAS crafts new vision and mission statements as it embarks on the next phase of its journey

Exciting new directions

WE'VE ALL HAD THE EXPERIENCE of starting out on a journey—business trip, weekend getaway, family vacation, overseas tour—that didn't turn out quite as we'd expected. Perhaps your carefully planned itinerary fell apart, and you ended up stranded at the airport talking to a stranger who became a valuable business contact. Or maybe the dreaded cross-country trek in the family vehicle turned out to be a laugh fest whose pleasures were surpassed only by the sight of the Grand Canyon at sunset.

Our lives are like that, too. You may decide to take a certain job or get involved in the community, and several years later you can see how those choices—and chance—shifted your perspective, values, or goals. In many ways you may have changed profoundly.

When I joined the IT Alumni Society about six years ago, I wanted to do something useful and to reconnect with the University. Over time, however, my motivation for staying involved in ITAS and my participation have broadened and deepened. Through my work with ITAS and my experience as a laboratory manager for 3M, I believe firmly that the University is critical to a strong state economy. The cornerstone of a successful, competitive business is a well-educated workforce, so it's no surprise to me that a large percentage of 3M's employees are University alumni—a situation that's probably true for many of Minnesota's high-tech companies. I want to do anything I can to advance the University's mission of education, research, and service.

The cornerstone of a successful, competitive business is a well-educated workforce, so it's no surprise to me that a large percentage of Minnesota's high-tech employees are University alumni.

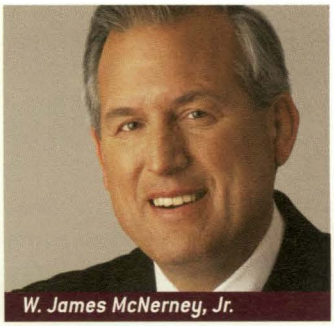
Like individuals, organizations also pause to assess their progress and direction. Last year an ad hoc committee led by past president Dick Hedger helped ITAS craft new vision and mission statements. In the process, we identified our primary stakeholders—the University, alumni, technology companies, and the state—and evaluated our interactions with those groups.

As a result, we made some changes in the society's committee structure. We disbanded the advancement committee, whose membership recruiting efforts duplicated the excellent job being done by the University of Minnesota Alumni Association.

In accord with our revised mission statement, we're going to work more closely with IT departments and professional organizations through our new University relations committee. Our goal is to strengthen our connections to the corporate world by leveraging ITAS activities with the networking being done by departments and professional groups.

This strategic planning has proven to be very fruitful, resulting in some new directions for ITAS. I'm excited to see ITAS change and grow as we work to advance education, science, and technology. If you want to help shape the direction of the alumni society in future years, I invite you to get involved by contacting Kris Kosek (612-626-8282) for more information. To read the new vision and mission statements, go to www.it.umn.edu/itas/about. ■

Richard Newell



W. James McNerney, Jr.

S&T BANQUET TO FEATURE 3M CEO McNERNEY

3M CEO JAMES McNERNEY, JR. will headline the 2002 Science & Technology Banquet. McNerney, who took the helm at 3M last January, previously held several senior posts at General Electric, including the top positions at GE Aircraft Engines and GE Lighting. He is expected to address a crowd of more than 700 at the Minneapolis Hilton on April 3. University president Mark Yudof and IT dean H. Ted Davis are also slated to appear. All proceeds from the banquet, IT's premier alumni event, benefit the ITAS Scholarship Fund. For more information or to reserve a table, call 612-626-1802 or see www.it.umn.edu/itas/banquet.

Carey trains for the shuttle mission at Johnson Space Center.

GOPHER SPIRIT SOARS INTO SPACE

LT. COL. (USAF) DUANE CAREY (Aerospace '81, M.S. '82) is proud of his Gopher heritage. He'll carry a banner emblazoned with University and IT logos into space during his first flight aboard the shuttle Columbia later this month. During the mission, Carey and other shuttle crew members will upgrade and service the Hubble Space Telescope, including the installation of the Hubble's newest scientific instrument, the Advanced Camera for Surveys. The high-resolution camera will take extremely detailed pictures of the inner regions of galaxies and search neighboring stars for planets. Carey has logged over 3,700 hours in more than 35 types of aircraft. NASA selected him as an astronaut candidate in 1996.

TOGETHER AGAIN **Dozens of IT alumni from 1951, 1961, and 1976 returned to campus in October for class reunions during Homecoming weekend. Participants attended a football game, campus tours, and a dinner with the dean, among other activities. Contact IT's alumni relations office if you're interested in attending a reunion in 2002.**

IT ALUMNI SOCIETY

Institute of Technology
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

itas@it.umn.edu
www.it.umn.edu/itas
612-626-8282

OPPORTUNITY

CONTINUED FROM PAGE 45

Mac system's easy-to-use programs. Brainerd's Aldus Corporation was spearheading an effort to bring its graphics program PageMaker to the PC, and Johnson signed on to lead the project.

"We had to rewrite the product completely," Johnson says, recalling the months of work. "We could use some of the big ideas, but it was an effort."

PageMaker for Microsoft Windows 1.02 was released in 1987 to major acclaim. Microsoft's Gates called it "the first really significant Windows application."

Johnson didn't bask in the glory for long. A relentless visionary, he longed to create a product that allowed business people to make pictures, graphs, and charts without endless toil.

"Most graphics programs out there at the time required a high level of skill," Johnson says. "[Existing programs] MacDraw and CorelDraw were difficult for people."

At the time, Linda was working as a financial auditor, and her struggles to create flowcharts fueled Johnson's desire to design a graphics tool for "everyman." In 1990, he co-founded Axon (later renamed Visio) Corporation to create a graphics program for people who weren't professional graphic artists.

The company received the necessary funding and eventually developed Visio, a graphics program able to perform a wide variety of tasks with a low degree of difficulty. Visio was an immediate hit, quickly becoming the best-selling drawing program in the marketplace.

In September 1999, Microsoft acquired Visio in a deal valued at $1.3 billion. "Our biggest motivation to approach Microsoft was to capitalize on their global marketing," Johnson says. "We're dealing with high-volume software purchasing, beyond personal purchases in a computer store."

> "It's really as simple as giving back to the community. The University is the biggest thing going in Minnesota. And Minnesota is the biggest thing going in the five-state area."
>
> —ALUMNUS TED JOHNSON

Johnson and his wife now live in Seattle, where he is vice president of Microsoft's business tools division. In fall 2001, they donated $1.5 million to the University. Their gift will fund the new Digital Design Consortium, a joint research and educational venture among University faculty in architecture, computer science, and other fields.

By combining design and digital technology, consortium researchers aim to create new tools that expand the boundaries of complex design modeling and allow designers to translate their ideas into multidimensional sketches. It's a natural fit for Johnson, whose University studies encompassed both fields.

The couple is currently building a house, and Johnson uses the process as an example of how the consortium may aid design projects in the future.

"As a client, I can visualize how much easier the process would be with good electronic design tools," he says. "An architect can visualize moving windows or doors, but it's hard to share that vision with a client. It would be a great asset to have better tools [with which] to communicate."

IT dean H. Ted Davis believes the consortium's work will bring the University to the forefront of digital design. "We are grateful to Linda and Ted for their generous gift and for inspiring the collaborative efforts of our faculty," he says. "No other university has as much potential as Minnesota to expand research in this area."

It only seems fitting that a man who displayed such remarkable vision at an early age should continue to cultivate a new kind of seeing.

"It's really as simple as giving back to the community," Johnson says. "The University is the biggest thing going in Minnesota. And Minnesota is the biggest thing going in the five-state area." ■

FOR MORE ON THIS STORY, TURN TO PAGE 51

Digital Design Consortium: Nurturing bright ideas

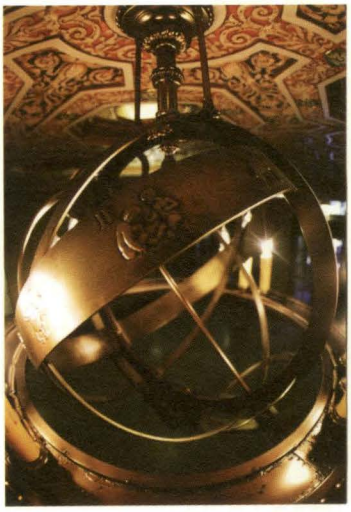
WHEN INSPIRATION STRIKES AWAY FROM THE OFFICE, DESIGNers may improvise and sketch their ideas on a dinner napkin or bank deposit slip. But on the job, computers and specialized software have become powerful tools for architects, engineers, and other design practitioners.

However, the usefulness of most existing digital tools is limited to the final stage of the design process. In architecture, for example, digital tools are used most often to code instruction information or to share a completed design.

Researchers associated with the University's new Digital Design Consortium will pioneer computer-based technologies and techniques that will move design to a new level. The next generation of digital design tools will support the early stages of the creative process and help designers convey visual information to their clients more effectively.

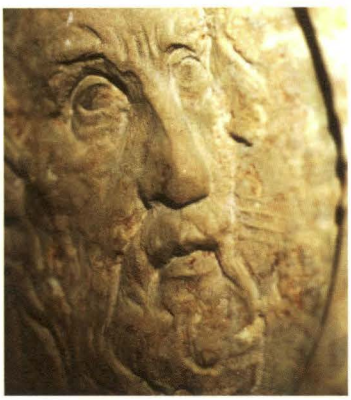
An inherently collaborative process, design embraces different areas of expertise and generates vast amounts of information. Digital technology can act as a decoder, helping translate a designer's vision and vast amounts of information into a common language of time, space, dimension, texture, sound, sight, and function. In effect, integrated digital design tools will help designers translate their ideas into multidimensional "napkin sketches" and test their ideas before implementation.

Created in September 2001 with a $1.5 million gift from alumni Ted and Linda Johnson, the consortium is a collaborative effort among leading designers, architects, computer science professionals, and University faculty from IT, the College of Architecture and Landscape Architecture, the Digital Technology Center, and the Design Institute. ■



SAVOR THE DETAILS

Architectural and design details add the finishing touch to Walter Library's historic character. A leisurely stroll through the library's public spaces, especially the first and second floors, reveals many delightful surprises. Some of the most enchanting details are above eye level. Left: In this sculpted lunette above the door to the north reading room, the female figure Law (center) is flanked by companion figures Science (left) and Power. An owl, symbolizing Wisdom, perches at her feet. Right: Zodiac symbols embellish this chandelier overlooking the main lobby. Below: The faces of Greek poet Homer and other scientific and literary figures are carved into the doorjambs of the Great Hall. Words and pictures can't convey the full beauty of the new Walter Library, however. Alumni, friends, and the public are welcome to visit the building's public spaces during the library's regular hours. For more information, call 612-624-0224 or see sciweb.lib.umn.edu.



MORE TO EXPLORE

THE FOLLOWING WEB SITES provide further information about the stories in this issue. You can find additional resources and a complete archive of *Inventing Tomorrow* online at www.it.umn.edu/inventing.

From the Dean (p. 3)
- www.it.umn.edu/about/dean

Technofile/R&D (p. 4)

Formula for a Top University
- thecenter.ufl.edu/research2001.html

Tin Whimsy
- www.menet.umn.edu/~uk/photos/ TinMan/TinMan.html

Crystalline Clarity
- www3.cems.umn.edu/research/ward

Cave Painting
- www.hep.umn.edu/soudan/brochure.html
- members.macconnect.com/users/g/giannetti/pages/mural.html

Strategic Supercomputing
- www.arc.umn.edu/research

Three Faculty Named to NAE
- www.nae.edu

Peak Experience (p. 8)
- www.UMabroad.umn.edu

Superhero Science (p. 10)
- www.physics.umn.edu/profiles/kakalios

Digital Dynasty (p. 14)
- www.dtc.umn.edu/default.html

Professor Andrew Odlyzko
- www.dtc.umn.edu/~odlyzko

Assistant Professor Baoquan Chen
- www.cs.umn.edu/faculty/baoquan

Professor Jiali Gao
- vesta.chem.umn.edu

Assistant Professor George Karypis
- www.cs.umn.edu/faculty/karypis

Visualizing the Big Picture
- www.lcse.umn.edu

Designing Digital Libraries
- digital.lib.umn.edu

A New Chapter for Walter Library (p. 22)
- www.it.umn.edu/walter
- sciweb.lib.umn.edu/walter/return.html
- www.lib.umn.edu/about/ul-firkins.phtml
- www.facm.umn.edu/facm/ Walter/walter.htm

Campaign Minnesota (p. 46)
- www.it.umn.edu/giving

ITAS Report (p. 48)
- www.it.umn.edu/itas

Retrospect (p. 52)
- www.lib.umn.edu/about/ul-walter.phtml

■ FRANK KELLOGG WALTER

Cornerstone of the University library

WITH THE ARRIVAL OF FRANK KEL-logg Walter, the University Library passed from its troubled childhood into hopeful adolescence. Under his direction, it matured into one of the nation's great research libraries. But the journey wasn't easy.

After languishing during the University's early days, the library seemed to be gaining momentum when Walter became its custodian in 1921. His predecessor, James Gerould, had nearly doubled the size of its collection, and the Minnesota legislature had finally appropriated $1.25 million for the construction of a new University library building.

Upon his arrival at the University, Walter helped plan the new facility, which earned universal praise for its elegance and efficiency when it opened on October 31, 1924.

With the new building, the University centralized the various library units and assigned control of the entire system to Walter. Although that move eventually strengthened the library and improved service, some faculty objected to having the books removed from departmental control. "A distinguished man in physics rushed angrily away to another assignment, protesting that since his books had been stolen away from him and secreted in the central library, all his activities had become paralyzed," wrote James Gray in his 1951 history of the University.

"In the modern scheme of education, the university library is primarily a central service station of the entire university," Walter said. Determined to improve the library's services, he launched a wide range of new projects, including the installation of a bindery to expedite book repair. More than 200,000 volumes were rehabilitated and restored to usefulness.

Frank Kellogg Walter

Walter also taught library science and, with the help of reference librarian Ina Firkins, organized a series of courses on library methods. In 1928, he established the University's Library School and served as its director. Nine years later, in 1937, he inaugurated a course for hospital librarians, the first of its kind in the nation.

He is best known, however, for developing the University of Minnesota Library into a premier research library. Under his stewardship, holdings quadrupled from 300,000 items to more than 1.3 million, and the library rose in rank from twelfth to sixth among North American university libraries. At one point, personnel from the Works Progress Administration were recruited to help catalog the rapidly growing collection.

"Walter was a bibliophile of the faith's most advanced order," wrote Gray. "The passion [to collect books] was upon him day and night, and wherever he paused in the course of the day became a place to seek treasure. His desk was piled high with books, books crowded his shelves and drifted like autumn leaves across his floor."

Walter died in 1945 at age 71, only two years after retiring as University librarian. In 1959, the Main Library building was renamed Walter Library in his honor.

At the end of his career, Walter must have regarded his achievements with keen satisfaction. Library use was at an all-time high, and the library's collection was burgeoning. In one of his final reports as University librarian, he noted with pleasure that undergraduates properly appreciated the library's services.

Frank Walter (far right), former University president William Watts Folwell (far left), and Graduate School dean Guy Stanton Ford—laid the cornerstone for the new main library building in a 1923 ceremony. (An unidentified construction worker stands behind them.)

UNIVERSITY ARCHIVES (2)

But in a more circumspect way, the report offers a telling clue about Walter and his choice of a profession. In it he relates a brief anecdote about an ancient Egyptian king who had the words "dispensary of the soul" inscribed above his beloved library. No doubt Walter felt a strong kinship with the ancient monarch, for whom the library was not a museum but rather a dynamic force that buoyed the human spirit.

Or, as Walter was fond of saying, "Books are bought for use, not as keepsakes." ■

INSTITUTE OF TECHNOLOGY

The Institute of Technology is a world-class teaching institution that offers undergraduate and graduate programs in engineering, science, and mathematics. Its mission is to provide programs of instruction, research, and service that are appropriate to a research university and that are responsible to the needs of the state, its citizens, and the nation.

CONTACT INFORMATION

Administration

Office of the Dean
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455
612-624-2006
800-587-3884

fax 612-624-2841
info@it.umn.edu
www.it.umn.edu

Other Offices and Services

Admissions
612-624-8504
admissions@it.umn.edu

Address Corrections
612-626-1802
address@it.umn.edu

Alumni Relations/
IT Alumni Society
IT Mentor Program
612-626-8282
itas@it.umn.edu

Career Services
612-624-4090
itcs@tc.umn.edu

Communications
Inventing Tomorrow
612-626-7959
inventingtomorrow@it.umn.edu

Development
612-624-5537
development@it.umn.edu

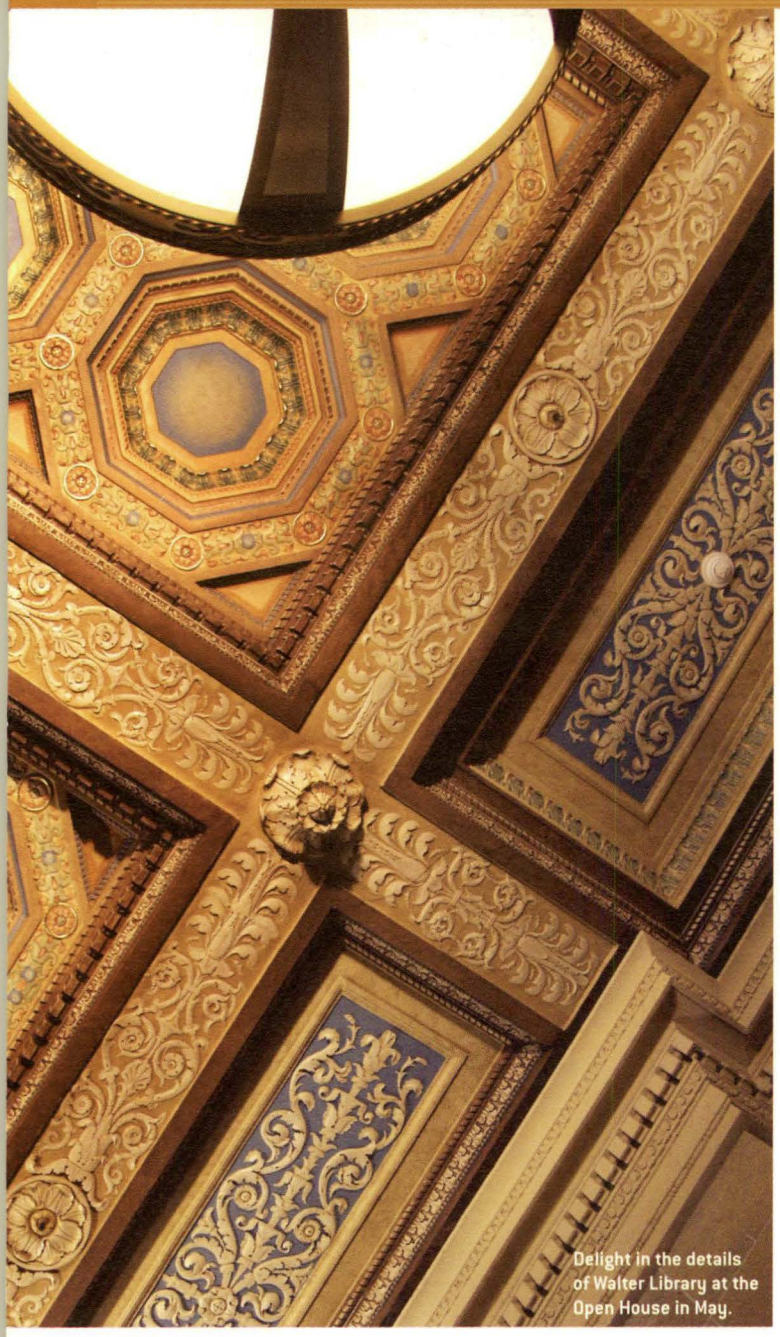
K-12 Programs (ITCEP)
612-625-2861
itcep@math.umn.edu

Minority Programs (APEXES)
612-626-0219
apexes@tc.umn.edu

Student Affairs
612-624-5091
studentaff@it.umn.edu

Women in IT
K-12 programs for girls
and young women
612-624-1317
women@it.umn.edu

www.it.umn.edu



Delight in the details of Walter Library at the Open House in May.

March

18 | **Technology-Enhanced Learning Symposium.** 7:00 p.m. Cowles Auditorium, Hubert Humphrey Institute. Christopher Dede and James Hirsch will be the guest lecturers at a symposium sponsored by the IT Alumni Society, the College of Education and Human Development (CEHD) Alumni Society, and CEHD Office of Continuing Professional Studies. Dessert reception to follow. $10 per person; students free with ID. To register, call 612-626-1601.

April

3 | **Science & Technology Banquet.** 5:30 p.m. Minneapolis Hilton. IT's premier annual event—a fundraiser, a social event, and a business networking opportunity for students, alumni, and corporate friends—features an address by 3M CEO James McNerney, Jr. Proceeds benefit the IT Alumni Scholarship Fund. FFI call 612-626-8282 or see www.it.umn.edu/itas/banquet.

8-12 | **IT Week.** IT's annual celebration includes a technology fair, goofy games, and other events. FFI call 612-626-1552.

11 | **Physics Circus.** Time TBA. St. Cloud State University. The Physics Force presents a show that will educate and entertain students of all ages. FFI see www.physics.umn.edu/pforce/.

May

1 | **Walter Library Open House.** 11:00 a.m.–1:00 p.m. Building tours and free lunch for students, staff, and alumni on Northrop Mall. FFI call 612-624-9339 or email waltercelebration@dtc.umn.edu.

10 | **IT Commencement.** 7:00 p.m. Northrop Auditorium. Pomp and circumstance for the graduating class of 2002. FFI call 612-624-8504.

June

8 | **Walter Library Gala Grand Opening.** Invitations to be mailed in May. FFI call 612-624-9339 or email waltercelebration@dtc.umn.edu.

Complete, up-to-date event listings are available online at www.it.umn.edu.

UNIVERSITY OF MINNESOTA

Institute of Technology
Office of the Dean
105 Walter Library
117 Pleasant Street SE
Minneapolis, MN 55455

Nonprofit Org.
U.S. Postage
P A I D
Minneapolis, MN
Permit No. 155

INSTITUTE OF **TECHNOLOGY**
engineering | physical sciences | mathematics